
Contents

Preface	<i>page</i> ix
1. Introduction	1
1.1. The Problem	1
1.2. Scope and treatment level	2
1.3. Notation and terminology	2
1.4. Galton's concept of regression	4
1.5. The modern concept of regression	5
2. Bivariate Normal and Least Squares Regression	7
2.1. The two cases of classical regression	7
2.2. Bivariate normal regression	7
2.3. An example of bivariate normal regression	9
2.4. Regression on a mathematical variable	12
2.5. Examples of regression on a mathematical variable	14
2.6. Some practical aspects of least squares regression	19
2.7. Adequacy of the simple least squares model	24
3. Law-like Relationships in the Presence of Random Variation	29
3.1. Functional and structural relationships	29
3.2. Comments on functional relationships	33
3.3. Behaviour of the maximum likelihood estimators with unknown variances	37
3.4. Functional relationships when there is information on departure variance	39
3.5. Structural relationships	44
3.6. Types of relationship arising in practice	45

4. Regression and Functional Relationship with Heterogeneous and Correlated Departures	47
4.1. Removal of departure restrictions in regression	47
4.2. Correlated departures in functional relationships	51
4.3. Regression models of the second kind	54
4.4. Some special patterns of correlations	58
4.5. Non-linear relationships and transformation of data	59
5. Multiple Regression	63
5.1. Multivariate regression	63
5.2. Multivariable regression	65
5.3. Orthogonal regressors	72
5.4. Polynomial and other special linear regression models	74
5.5. Choice of regressors	75
5.6. Multiple regressions with correlated departures	79
5.7. Models of the second kind	82
6. Multidimensional Functional Relationships and Canonical Analysis	85
6.1. Multiplicity of functional relationships	85
6.2. Determination of a single linear functional relationship	88
6.3. Confidence limits for a single relationship	89
6.4. Determination of more than one linear relationship	91
6.5. Canonical analysis	92
7. Some Applications of the Classical Regression Model	95
7.1. The use of regression analysis	95
7.2. Inverse estimation	97
7.3. Comparison of regression equations	99
7.4. Parallel and identical regression lines and planes	100
7.5. Concurrent lines	104
7.6. Two phase regressions	106
7.7. Residuals	108
7.8. Regression analysis of designed experiments	112
7.9. Analysis of covariance	117
7.10. Linear transformations of the dependent variate	118

8. Law-like Relationships in Practice	121
8.1. Number and type of relationships	121
8.2. Regression with arbitrary choice of regressors	133
8.3. How linear relationships may arise in practice	134
8.4. Other methods of estimating functional relationships	135
9. Miscellaneous Topics in Linear Regression	138
9.1. The probit regression line	138
9.2. Berkson's model with controlled variables	143
9.3. Bias due to ignoring correlations between departures	144
9.4. Some topics omitted	147
10. Non-linear Models	149
10.1. Non-linear least squares	149
10.2. Estimation of parameters in a rational function	152
10.3. Fitting the generalized logistic curve	155
10.4. Relaxation of assumptions about departures	158
10.5. Curve fitting and approximation theory	158
References	161
Author Index	167
Subject Index	169