

CONTENTS

Preface	iii
Notation and Abbreviations	xiii
CHAPTER 1: REGRESSION AND CORRELATION AMONG SEVERAL VARIABLES	1
1. Multivariate Analysis	1
2. Multivariate Distributions	4
3. Regression, Partial and Multiple Correlation	9
4. The Multinomial Distribution	18
References to Chapter 1	22
CHAPTER 2: MULTIVARIATE NORMAL DISTRIBUTION	23
1. Multivariate Normal Distribution	23
2. A Random Sample from $N_p(\underline{x} \underline{\mu} \Sigma)$	28
3. Orthogonal Transformations	30
4. Conditional Distribution	34
5. Quadratic Forms in Normal Variables	39
References to Chapter 2	46
CHAPTER 3: THE WISHART DISTRIBUTION	47
1. Maximum Likelihood Estimates of the Mean Vector and the Variance-Covariance Matrix	47
2. The Wishart Distribution in the Canonical Case	51
3. The Wishart Distribution in the General Case	56
4. Distributions of the Maximum Likelihood Estimates of $\underline{\mu}$ and Σ	60
5. Miscellaneous Results Associated with the Wishart Distribution	63

6.	The Characteristic Function of the Wishart Distribution	73
7.	Distribution of XAX'	76
8.	The Non-Central Wishart Distribution	77
	References to Chapter 3	81
CHAPTER 4:	DISTRIBUTIONS ASSOCIATED WITH REGRESSION	83
1.	Distribution of the Correlation Coefficient	83
2.	Distribution of the Multiple Correlation Coefficient	94
3.	Distribution of the Matrix of Correlation Coefficients	102
4.	Distributions of the Matrix of Regression Coefficients and the Residual s.s. and s.p. Matrix	106
5.	Multiple Regression of x_p on x_1, \dots, x_{p-1}	112
6.	Distribution of the Partial Correlation Coefficient	115
7.	Determination of $d(2, n, p)$	116
	References to Chapter 4	119
CHAPTER 5:	HOTELLING'S T^2 AND ITS APPLICATIONS	121
1.	Hotelling's T^2 and Its Distribution	121
2.	Application of the Union-Intersection Principle to Obtain Hotelling's T^2	131
3.	Distribution of Rao's U Statistic	135
4.	Applications of Hotelling's T^2	141
5.	Applications of Hotelling's T^2 in Problems Involving Linear Hypotheses	170
6.	Optimum Properties of Hotelling's T^2 Test.	182
	References to Chapter 5	184
CHAPTER 6:	DISCRIMINANT ANALYSIS	187
1.	Procedure for Discrimination	187
2.	The Sample Discriminant Function	195
3.	Tests Associated with Discriminant Functions	200
4.	Analogy of Discriminant Analysis with Regression Analysis	206

5.	Standard Errors of Discriminant Function Coefficients	214
6.	Chance of Misclassification When Anderson's Statistic is Used	218
7.	Penrose's Size and Shape Factors	225
8.	Discriminant Analysis in the Case of Unequal Variance-Covariance Matrices	228
9.	Discrimination in the Case of Zero Mean Differences	230
10.	Discrimination in the Case of Qualitative Data	234
11.	Concluding Remarks	242
	References to Chapter 6	244
CHAPTER 7: CANONICAL VARIABLES AND CANONICAL CORRELATIONS.		247
1.	Singular Decomposition of a Matrix	247
2.	Canonical Variables and Canonical Correlations	249
3.	Sample Canonical Correlations and Canonical Variables	256
4.	Representation of an Orthogonal Matrix in Terms of Rotation Angles	259
5.	Distribution of the Sample Canonical Correlation Coefficients	261
6.	Distribution of the Canonical Vectors	274
7.	Some Miscellaneous Results about Canonical Correlations	277
8.	Canonical Analysis	280
	References to Chapter 7	286
CHAPTER 8: WILKS'S Λ CRITERION		289
1.	Wilks's Λ Criterion	289
2.	The Distribution of Wilks's Λ	292
3.	Bartlett's Approximation to Wilks's Λ	300
4.	Independence of Two Vectors	304
5.	Test for a Subhypothesis Associated with β	311
6.	Factors of Wilks's Λ	320

7. Tests of Significance of the Residual Roots	325
8. Alternatives to Wilks's Λ Criterion . . .	331
References to Chapter 8	335

CHAPTER 9: MULTIVARIATE ANALYSIS OF VARIANCE AND DISCRIMINATION IN THE CASE OF SEVERAL GROUPS 341

1. Multivariate Analysis of Variance: One-Way Classification	341
2. Discrimination in Case of Several Groups.	354
3. Subdivision of the "Between Groups" s.s. and s.p. Matrix	366
4. Goodness of Fit of a Single Hypothetical Discriminant Function in the Case of Several Groups	374
5. An Alternative Method of Discrimination	378
6. Use of Canonical Analysis in Contingency Tables	379
7. The General Theory of Multivariate Analysis of Variance and Covariance	385
8. A General Incomplete Block Design	390
References to Chapter 9	397

CHAPTER 10: LIKELIHOOD RATIO TESTS 400

1. Likelihood Ratio Criteria for Certain Hypotheses	400
2. Moments of λ_a , λ_b , λ_c	405
3. Independence of k Sets of Variates	411
4. The Sphericity Test	418
References to Chapter 10	423

CHAPTER 11: PRINCIPAL COMPONENTS 424

1. Principal Components of a Random Vector	424
2. Optimality Properties of Principal Components	426
3. Singular Normal Distribution	433
4. Sample Principal Components	436
5. Distributions Associated with the Sample Principal Components (Null Case)	440

6. Asymptotic Distributions	442
7. Tests of Certain Hypotheses About Principal Components	444
8. Correlation Matrix	455
9. Geometrical Interpretation of Principal Components	458
10. Principal Component Analysis	459
References to Chapter 11	465
Exercises	469
References for Exercises	520
Appendix: Jacobians of Certain Transformations	525
<i>ERRATA</i>	526
<i>INDEX</i>	527