VAR **METHOD**

Hochschulrechenzentrum

Donald F. Morrison

Professor of Statistics

The Wharton Schowechnische Universität Darmetadt University of PennsylvaniaCHBEREICH INFORMATIK

Inventar-Nr.: 105-00198

Second Edition Sachgebiete: Makenahin

Standort:

McGRAW-HILL BOOK COMPANY

New York St. Louis San Francisco Auckland Düsseldorf Johannesburg Kuala Lumpur London Mexico Montreal New Delhi Panama Paris São Paulo Singapore Sydney Tokoyo Toronto

CONTENTS

Prefa	ace to the Second Edition	
Prefa	ice to the First Edition	X
SOME	E ELEMENTARY STATISTICAL CONCEPTS	
1.1	Introduction	
1.2	Random Variables	
1.3	Normal Random Variables	
1.4	Random Samples and Estimation	
1.5	Tests of Hypotheses for the Parameters of Normal	
	Populations	
1.6	Testing the Equality of Several Means: The Analysis	
	of Variance	
	RIX ALGEBRA	
2.1	Introduction	
2.2	Some Definitions	
2.3	Elementary Operations with Matrices and Vectors	
2.4	The Determinant of a Square Matrix	
2.5	The Inverse Matrix	
2.6	The Rank of a Matrix	
2.7	Simultaneous Linear Equations	
2.8	Orthogonal Vectors and Matrices	
2.9	Quadratic Forms	
2.10		
2.11	Partitioned Matrices	
2.12	Differentiation with Vectors and Matrices	
2.13	Further Reading	
2.14	Exercises	
SAMI	PLES FROM THE MULTIVARIATE NORMAL POPULATION	`-
3.1	Introduction	
3.2	Multidimensional Random Variables	
3.3	The Multivariate Normal Distribution	
3.4	Conditional and Marginal Distributions of Multi-	
J. 1	normal Variates	
3.5	Samples from the Multinormal Population	
3.6	Correlation and Regression	
U.U	COLLOID II AILA TICELCOSION	

viii	Contents				
	3.7	Simultaneous Inferences about Regression Coefficients	111		
	3.8	Inferences about the Correlation Matrix	116		

3.9	Samples with Incomplete Observations	120
3.10	Exercises	124

3.9	Samples with Incomplete Observations	120
3.10	Exercises	124
TESTS	S OF HYPOTHESES ON MEANS	128
4.1	Introduction	128
4.2	Tests on Means and the T^2 Statistic	128
4.3	Simultaneous Inferences for Means	134
4.4	The Case of Two Samples	136
4.5	The Analysis of Repeated Measurements	141
4.6	Profile Analysis for Two Independent Groups	153
4.7	The Power of Tests on Mean Vectors	160
4.8	Some Tests with Known Covariance Matrices	164
4.9	Exercises	166
THE	MULTIVARIATE ANALYSIS OF VARIANCE	170
5.1	Introduction	170
5.2	The Multivariate General Linear Model	170
5.3	The Multivariate Analysis of Variance	179
5.4	The Multivariate Analysis of Covariance	193
5.5	Multiple Comparisons in the Multivariate Analysis	
	of Variance	197

	of Variance	197
5.6	Profile Analysis	205
5.7	Curve Fitting for Repeated Measurements	216
- 0	Other Test Cuiteria	വവ

-	5.9	Exercises		22

CLASSIFICATION BY THE LINEAR

6.6

Exercises

DISC	RIMINANT FUNCTION	230
6.1	Introduction	23 0
6.2	The Linear Discriminant Function for Two Groups	2 31
6.3	Classification with Known Parameters	2 33
6.4	Estimation of the Misclassification Probabilities	236
6.5	Classification for Several Groups	239

245

INFE	RENCES FROM COVARIANCE MATRICES	247
7.1	Introduction	24'
7.2	Hypothesis Tests for a Single Covariance Matrix	24'

	Contents	ix
7.3	Tests for Two Special Patterns	250
7.4	Testing the Equality of Several Covariance Matrices	252
7.5	Testing the Independence of Sets of Variates	253
7.6	Canonical Correlation	259
7.7	Exercises	264
THE S	TRUCTURE OF MULTIVARIATE OBSERVATIONS:	
I. PRI	NCIPAL COMPONENTS	266
8.1	Introduction	266
8.2	The Principal Components of Multivariate	
	Observations	267
8.3	The Geometrical Meaning of Principal Components	275
8.4	The Computation of Principal Components	279
8.5	The Interpretation of Principal Components	2 86
8.6	Some Patterned Matrices and Their Principal	
	Components	289
8.7	The Sampling Properties of Principal Components	292
8.8	Exercises	299
	CTOR ANALYSIS	302
9.1	Introduction	
	TOU DAT 13 1: 1 DAT 1-1 C TO 1 C44	
	The Mathematical Model for Factor Structure	304
9.3	Estimation of the Factor Loadings	$\frac{304}{307}$
$9.3 \\ 9.4$	Estimation of the Factor Loadings Numerical Solution of the Estimation Equations	304 307 311
9.3 9.4 9.5	Estimation of the Factor Loadings Numerical Solution of the Estimation Equations Testing the Goodness of Fit of the Factor Model	304 307 311 314
9.3 9.4 9.5 9.6	Estimation of the Factor Loadings Numerical Solution of the Estimation Equations Testing the Goodness of Fit of the Factor Model Examples of Factor Analyses	304 307 311 314 316
9.5 9.6 9.7	Estimation of the Factor Loadings Numerical Solution of the Estimation Equations Testing the Goodness of Fit of the Factor Model Examples of Factor Analyses Factor Rotation	304 307 317 314 316 319
9.3 9.4 9.5 9.6 9.7 9.8	Estimation of the Factor Loadings Numerical Solution of the Estimation Equations Testing the Goodness of Fit of the Factor Model Examples of Factor Analyses Factor Rotation An Alternative Model for Factor Analysis	304 307 311 314 316 319 329
9.3 9.4 9.5 9.6 9.7 9.8 9.9	Estimation of the Factor Loadings Numerical Solution of the Estimation Equations Testing the Goodness of Fit of the Factor Model Examples of Factor Analyses Factor Rotation An Alternative Model for Factor Analysis Sampling Variation of Loading Estimates	304 307 317 314 316 319 329 332
9.3 9.4 9.5 9.6 9.7 9.8 9.9 9.10	Estimation of the Factor Loadings Numerical Solution of the Estimation Equations Testing the Goodness of Fit of the Factor Model Examples of Factor Analyses Factor Rotation An Alternative Model for Factor Analysis Sampling Variation of Loading Estimates The Evaluation of Factors	304 307 317 316 319 329 332
9.3 9.4 9.5 9.6 9.7 9.8 9.9	Estimation of the Factor Loadings Numerical Solution of the Estimation Equations Testing the Goodness of Fit of the Factor Model Examples of Factor Analyses Factor Rotation An Alternative Model for Factor Analysis Sampling Variation of Loading Estimates The Evaluation of Factors Models for the Dependence Structure of Ordered	304 307 317 314 316 319 329 333 334
9.3 9.4 9.5 9.6 9.7 9.8 9.9 9.10 9.11	Estimation of the Factor Loadings Numerical Solution of the Estimation Equations Testing the Goodness of Fit of the Factor Model Examples of Factor Analyses Factor Rotation An Alternative Model for Factor Analysis Sampling Variation of Loading Estimates The Evaluation of Factors Models for the Dependence Structure of Ordered Responses	304 307 317 316 319 329 337 336 336
9.3 9.4 9.5 9.6 9.7 9.8 9.9 9.10	Estimation of the Factor Loadings Numerical Solution of the Estimation Equations Testing the Goodness of Fit of the Factor Model Examples of Factor Analyses Factor Rotation An Alternative Model for Factor Analysis Sampling Variation of Loading Estimates The Evaluation of Factors Models for the Dependence Structure of Ordered	304 307 317 316 319 329 337 336 336
9.3 9.4 9.5 9.6 9.7 9.8 9.9 9.10 9.11	Estimation of the Factor Loadings Numerical Solution of the Estimation Equations Testing the Goodness of Fit of the Factor Model Examples of Factor Analyses Factor Rotation An Alternative Model for Factor Analysis Sampling Variation of Loading Estimates The Evaluation of Factors Models for the Dependence Structure of Ordered Responses	304 307 311 314 316 319 329 332 334 348
9.3 9.4 9.5 9.6 9.7 9.8 9.9 9.10 9.11	Estimation of the Factor Loadings Numerical Solution of the Estimation Equations Testing the Goodness of Fit of the Factor Model Examples of Factor Analyses Factor Rotation An Alternative Model for Factor Analysis Sampling Variation of Loading Estimates The Evaluation of Factors Models for the Dependence Structure of Ordered Responses Exercises	302 304 307 311 314 316 319 329 332 334 346 346
9.3 9.4 9.5 9.6 9.7 9.8 9.9 9.10 9.11	Estimation of the Factor Loadings Numerical Solution of the Estimation Equations Testing the Goodness of Fit of the Factor Model Examples of Factor Analyses Factor Rotation An Alternative Model for Factor Analysis Sampling Variation of Loading Estimates The Evaluation of Factors Models for the Dependence Structure of Ordered Responses Exercises RENCES ENDIX TABLES AND CHARTS	304 307 311 314 316 329 332 334 346
9.3 9.4 9.5 9.6 9.7 9.8 9.9 9.10 9.11	Estimation of the Factor Loadings Numerical Solution of the Estimation Equations Testing the Goodness of Fit of the Factor Model Examples of Factor Analyses Factor Rotation An Alternative Model for Factor Analysis Sampling Variation of Loading Estimates The Evaluation of Factors Models for the Dependence Structure of Ordered Responses Exercises RENCES ENDIX TABLES AND CHARTS Table 1 Cumulative Normal Distribution Function	304 307 311 314 316 329 332 334 345
9.3 9.4 9.5 9.6 9.7 9.8 9.9 9.10 9.11	Estimation of the Factor Loadings Numerical Solution of the Estimation Equations Testing the Goodness of Fit of the Factor Model Examples of Factor Analyses Factor Rotation An Alternative Model for Factor Analysis Sampling Variation of Loading Estimates The Evaluation of Factors Models for the Dependence Structure of Ordered Responses Exercises RENCES ENDIX TABLES AND CHARTS	30 30 31 31 31 32 33 33 34 34

x Contents

Table 3 Upper Percentage Points of the t	
Distribution	367
Table 4 Upper Percentage Points of the F	
Distribution	368
Table 5 The Fisher z Transformation	370
Charts 1-8 Power Functions of the F Test	371
Charts 9-16 Upper Percentage Points of the Distri-	
and bution of the Largest	
Tables 6-14 Characteristic Root	379
Indexes	404
Name Index	
Subject Index	