Understanding Correlation Matrices

Alexandria Hadd

Spelman College

Joseph Lee Rodgers

Vanderbilt University

Quantitative Applications in the Social Sciences, Volume 186



Los Angeles | London | New Delhi Singapore | Washington DC | Melbourne

TABLE OF CONTENTS

Series Editors Introduction	xi
Preface	xiii
Acknowledgments	
About the Authors	xvii
Chapter 1: Introduction	1
The Correlation Coefficient: A Conceptual Introduction	2
The Covariance	3
The Correlation Coefficient and Linear Algebra:	
Brief Histories	5
Examples of Correlation Matrices	8
Summary	15
Chapter 2: The Mathematics of Correlation Matrices	17
Requirements of Correlation Matrices	18
Eigenvalues of a Correlation Matrix	20
Pseudo-Correlation Matrices and Positive Definite Matrices	21
Smoothing Techniques	23
Restriction of Correlation Ranges in the Matrix	25
The Inverse of a Correlation Matrix	25
The Determinant of a Correlation Matrix	26
Examples	27
Racial Composition of NBA and Sponsor Cities	27
Girls' Intelligence Across Development	27
Summary	28
Chapter 3: Statistical Hypothesis Testing on Correlation Matrices	29
Hypotheses About Correlations in a Single Correlation Matrix	30
Testing Equality of Two Correlations in a Correlation	
Matrix (No Variable in Common)	30
Testing Equality of Two Correlations in a Correlation	
Matrix (Variable in Common)	32

Testing Equality to a Specified Population Correlation	
Matrix	33
Hypotheses About Two or More Correlation Matrices	37
Testing Equality of Two Correlation Matrices From	
Independent Groups	37
Testing Equality of Several Correlation Matrices	40
Testing Equality of Several Correlations From	
Independent Samples	42
Testing for Linear Trend of Eigenvalues	43
Summary	45
Chapter 4: Methods for Correlation/Covariance	
Matrices as the Input Data	47
Factor Analysis	48
Summary	48
Example	50
Resources for Software and Additional Readings	51
Structural Equation Modeling	52
Summary	52
Examples	54
Resources for Software and Additional Readings	57
Meta-Analysis of Correlation Matrices	58
Summary	58
Recent MASEM Examples	59
Resources for Software and Additional Readings	59
Summary	60
Chapter 5: Graphing Correlation Matrices	63
Graphing Correlations	65
Graphing Correlation Matrices	69
The Scatterplot Matrix	70
The Scatterplot Matrix, Enhanced	70
Corrgrams Using the corrplot Package in R	74
Heat Maps	75
Parallel Coordinate Plots	78
Eigenvector Plots	81
Summary	84

Chapter 6: The Geometry of Correlation Matrices	85
What Is Correlation Space?	85
The 3 × 3 Correlation Space	87
Properties of Correlation Space: The Shape and Size	90
Convexity of the Space	90
Number of Vertices and Edges	90
Volume Relative to Space of Pseudo-Correlations	91
Uses of Correlation Space	92
Similarity of Correlation Matrices	92
Generating Random Correlation Matrices	94
Fungible Correlation Matrices	94
Defining Correlation Spaces Using Angles	95
Example Using 3×3 and 4×4 Correlation Space	96
Summary	99
Chapter 7: Conclusion	101
References	105
Index	113

•