COMPARISON OF FACTOR EXTRACTION AND ROTATION METHODS IN EXPLORATORY FACTOR ANALYSIS

S.M.P.Siriwardhana

(08/10308)

Dissertation submitted in partial fulfilment of the requirements for the degree Master of Science in Operational Research

Department of Mathematics

University of Moratuwa

Sri Lanka

April 2012

Declaration of the Candidate

"I declare that this is my own work and this dissertation does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any University or other institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another except where the acknowledgment is made in the text"

Signature: UOM Verified Signature Date : 21.04.'12

Declaration of the Supervisor

"I have supervised and accepted this thesis/dissertation for the award of the degree"

Signature: Date:

To my Parents and Husband

ACKNOWLEDGEMENT

Writing a thesis is a long journey which one cannot travel alone. It requires patience, encouragement, and support from many people, specially one's supervisor. I would like to take this opportunity to extend my sincere respect and gratitude to my supervisor Dr.T.S.G.Peiris (Senior Lecturer in Statistics, Department of Mathematics, University of Moratuwa) for his intellectual inspiration, patience, guidance and encouragement. Without him this thesis could not have been completed.

Also I would like to thank all of my colleagues with whom I studied at the University of Moratuwa. Their encouragement and support are very much appreciated.

Last but not least, I would like to deeply thank my parents and my husband who always stand by me.

ABSTRACT

Exploratory Factor Analysis (EFA) is a technique to explore the underlying factors of a large set of observed variables which cannot be measured directly. In general there are seven types of factor extraction methods. For a meaningful interpretation of occurred factor model, the extraction method usually followed by either Orthogonal rotation or Oblique rotation method. However it has not been recommended a particular method of EFA for a given set of data. Further most of the researchers are misusing Principal Component Analysis (PCA) with Exploratory Factor Analysis. Therefore, this study was carried out to investigate a possibility of recommending a particular method for a given set of data using a data set comprising seven variables on crimes. Data were analysed using the statistical software SPSS.

To illustrate the contrast of PCA and EFA, analysis was begun with Principle Component. For the comparison of different types of extraction methods under EFA, variables were extracted using Maximum Likelihood Factoring, Principle Axis Factoring and General Least Squares followed by all the Orthogonal rotation methods separately. The steps of the analysis in EFA were quite same with all the extraction methods, however the final result and the effect of the prior assumptions make difference. It is very important to confirm that KMO statistic to be greater than 0.6, prior to carry out EFA for the adequacy of sample size in order to derive valid statistical inferences. If the variables having multivariate normal distribution it is recommended to conduct Maximum Likelihood or General Least Squares. For the non normal distributions, Principle axis factoring is recommended. However it is recommended to compare the results from each method irrespective of the distribution of data set.

Among Orthogonal rotations Varimax rotation is recommended as it provides simple factor loadings to interpret. Quartimax generally does not provide simple factor loadings as in Varimax. It is not recommended to carry out all possible combinations of factor extraction methods and rotation methods to any set of data, as same results will not be produced by each combination. The recommendation given for the particular data set was confirmed using Jackknife validation method.

Keywords: Factor analysis, Generalized Least Squares, Maximum Likelihood Extraction, Orthogonal rotations, Principal Axis Factoring

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

Abbreviation	Description
FA	Factor Analysis
PCA	Principle Component Analysis
EFA	Exploratory Factor Analysis
ML	Maximum Likelihood
PF	Principle Factoring (Using for Principal Axis Factoring)
GLS	Generalized Least Squares
V	Variance