
Exploratory Factor Analysis.pdf

Advice on Exploratory Factor Analysis

Introduction

Exploratory Factor Analysis (EFA) is a process which can be carried out in SPSS to extract scores of **items** on a questionnaire. The purpose of an EFA is to describe a multidimensional data set using fewer variables. Once a questionnaire has been validated, another process called Confirmatory Factor Analysis can be used. This is supported by AMOS, a 'water' package in SPSS.

There are two forms of EFA known as Factor Analysis (FA) and Principal Component Analysis (PCA). The reduced dimensions produced by a FA are known as **factors** whereas those produced by a PCA are known as **components**. PCA will always work but FA may not converge to a solution.

FA analyses the relationship between the individual item variances and common variances shared between items whereas the PCA analyses the relationships between the individual item variances and total (both common and error) variances shared between items. FA is therefore preferable to PCA in the early stages of an analysis as it allows you to measure the ratio of an item's unique variance to its shared variance, known as its **communality**. As dimension reduction techniques seek to identify items with a shared variance, it is advisable to remove any item with a communality score less than 0.2 (Cohen, 2006). Items with low communality scores may indicate additional factors which could be explored in further studies for developing and measuring additional items (Gorsuch and Osborne, 2006).

There are different **EFA methods**. If you are only dealing with your sample for further analysis (i.e. it is a population in terms of the EFA) it is advisable to use the **Principal Axis Factoring** method. Otherwise, if you are trying to develop an instrument to be used with other data sets in the future, it is advisable to use a sample-based EFA method such as **Maximum Likelihood** or **Kaiser's alpha factoring** (Feldt, 2013; SP4 475).

Whether to **rotate the factors** and the type of rotation used also needs to be decided. An **orthogonal rotation** can improve the solution from the unrotated one but it forces the factors to be independent of each other. The most popular orthogonal rotation technique is **varimax**. An **oblique rotation** allows a degree of correlation between the factors in order to represent the interrelationship between the items within the factors. Although Fabrigar et al. (2000) give several reasons why it should be considered, it is more difficult to interpret as it is advised that it should only be considered if the orthogonal solution is unacceptable. Feldt (2013: 481) recommends using either the **oblimin solution** or **promax** rotation with the default parameter settings. An oblique rotation creates two additional factor matrices called **pattern** and **structure**. It is the pattern matrix which needs to be analysed in the same way as the single rotated factor matrix obtained from orthogonal rotations.

Each item is given a score for each factor. Following the advice of Feldt (2013: 480) we recommend **suppressing factor loadings less than 0.3**. Any item with all scores suppressed should be removed. Items greater than 0.4 are considered viable (Quadevall and Ylitalo, 1986). Items should not cross-load too highly between factors (measured by the ratio of loadings being greater than 75%). There should be as many factors as possible with **at least 3 non-zero loading items with an acceptable loading score**. Items should be removed one-by-one until the solution satisfies all the requirements. The number of extracted factors may need to be reduced during the process.

After the EFA has been carried out there is a **validation process**. There are different ways to extract and double-check the derived scales. For a successful analysis there should be a **higher average correlation between the items in the derived scales than the average correlation between the scales**. The proportion of the total variance explained by the

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