



Exploratory Factor Analysis

1. Introduction

In an exploratory factor analysis, one wants to explore the empirical data to discover and detect characteristic features and interesting relationships without imposing any definite model on the data. An exploratory factor analysis may be structure generating, model generating, or hypothesis generating. In confirmatory factor analysis, on the other hand, one builds a model assumed to describe, explain, or account for the empirical data in terms of relatively few parameters.

Exploratory factor analysis is a technique often used to detect and assess latent sources of variation and covariation in observed measurements. It is widely recognized that exploratory factor analysis can be quite useful in the early stages of experimentation or test development.

2. Exploratory Factor Analysis of Nine Psychological Variables

To illustrate exploratory factor analysis we use a classical data set. Holzinger and Swineford (1939) collected data on twenty-six psychological tests administered to 145 seventh- and eighth-grade children in the Grant-White school in Chicago. Nine of these tests are selected for this example. The nine selected variables and their intercorrelations are given in the table below.

Table 1: Correlation Matrix for Nine Psychological Variables

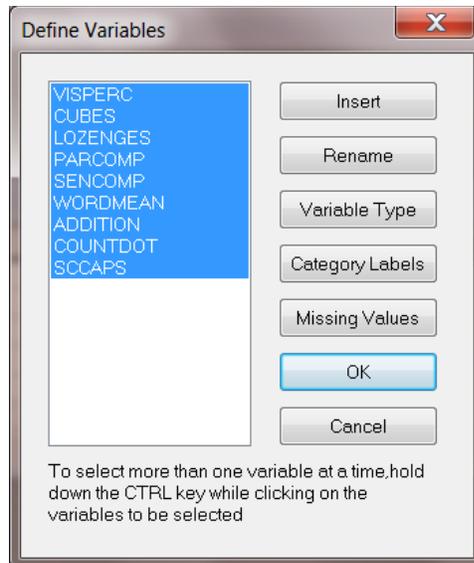
VIS PERC	1.000								
CUBES	0.326	1.000							
LOZENGES	0.449	0.417	1.000						
PAR COMP	0.342	0.228	0.328	1.000					
SEN COMP	0.309	0.159	0.287	0.719	1.000				
WORDMEAN	0.317	0.195	0.347	0.714	0.685	1.000			
ADDITION	0.104	0.066	0.075	0.209	0.254	0.178	1.000		
COUNTDOT	0.308	0.168	0.239	0.104	0.198	0.121	0.587	1.000	
S-C CAPS	0.487	0.248	0.373	0.314	0.356	0.222	0.418	0.528	1.000

Use the **File Open** menu, select file of the type ***.Isf** and choose the file **npv.Isf** from the **Prelis examples** folder. This file contains 145 observations on the nine psychological measurements.

	VISPERC	CUBES	LOZENGES	PARCOMP	SENCOMP	WORDMEAN
1	23.00	19.00	4.00	10.00	17.00	10.00
2	33.00	22.00	17.00	8.00	17.00	10.00
3	34.00	24.00	22.00	11.00	19.00	19.00
4	29.00	23.00	9.00	9.00	19.00	11.00
5	16.00	25.00	10.00	8.00	25.00	24.00
6	30.00	25.00	20.00	10.00	23.00	18.00

The nine psychological variables should be treated as continuous variables. The PRELIS default variable type, however, is ordinal. To change the default variable type, choose the **Data, Define Variables...** option then select all the variables in the variable list and click the **Variable Type** button.

All the variables can be selected simultaneously by clicking on the first variable and then, with the left mouse button held down, dragging the cursor over the remaining variables.

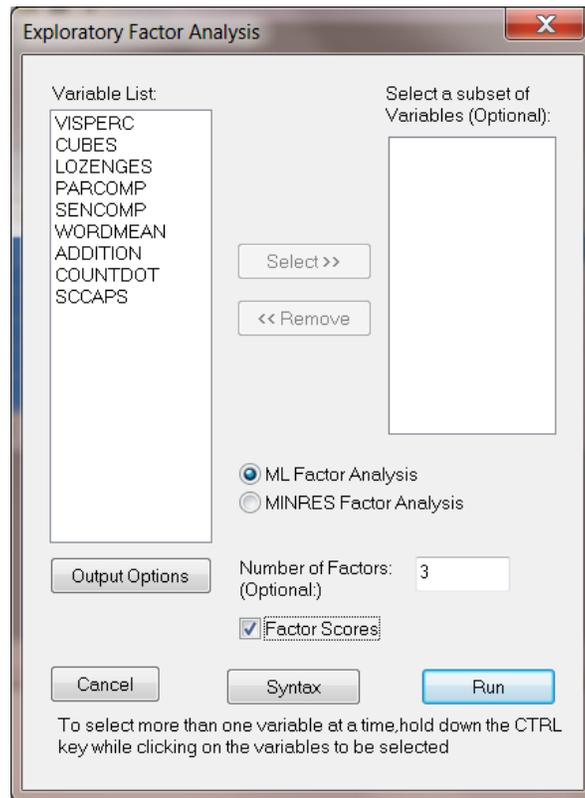


Change the variable type to continuous and click **OK** when done. If only one variable had been selected, use of the **Apply to all** check box, would have changed all the variables in the list from ordinal to continuous variables.

Although LISREL can determine the number of factors to be extracted if this is not specified by the user, we shall assume that the number of factors equals three.

An exploratory factor analysis is done by selecting the **Exploratory Factor Analysis** option from the **Statistics** menu to obtain the **Exploratory Factor Analysis** dialog box.

Not all the variables in a data set may be suitable for a factor analysis, since the data may contain demographic variables such as marital status, gender, etc. A subset of the list of variables may therefore be selected. For the present example, all nine variables are used and therefore we do not have to use the **Select** button. Enter 3 for the **Number of Factors** and click **Run** to produce output or **Syntax** to view (and possibly modify) the syntax file before running PRELIS. Factor scores will be saved in the file **npv.fsc**.



A portion of the factor analysis output is shown below.

NPV.OUT

Promax-Rotated Factor Loadings

	Factor 1	Factor 2	Factor 3	Unique Var
VISPERC	0.678	0.039	0.031	0.499
CUBES	0.531	-0.013	-0.051	0.740
LOZENGES	0.670	0.064	-0.059	0.535
PARCOMP	0.074	0.848	-0.045	0.241
SENCOMP	0.007	0.805	0.086	0.302
WORDMEAN	0.083	0.796	-0.049	0.322
ADDITION	-0.184	0.131	0.793	0.388
COUNTDOT	0.200	-0.145	0.774	0.317
SCCAPS	0.431	0.041	0.446	0.456