

Factor Analysis Using SPSS

Overview

For this computer assignment, you will conduct a series of principal factor analyses to examine the factor structure of a new instrument developed to assess cognitive interference individuals experience in an evaluative situation. Students in the course will be divided into six groups, with each group performing a different set of analyses that will be reported to the class. You will report your findings to the class on Monday, September 22, 2003.

Data

You will conduct your analyses using data from a longitudinal study of cognitive interference and academic performance for which the first-year students were recruited in the Fall, 2002, Term. Students completed a revised version of the Cognitive Interference Questionnaire (Sarason, Sarason, Keefe, Hayes, & Shearin, 1986) after they took the Quantitative Literacy Examination. The revised CIQ—referred to as the CIQ-R—was intended to assess three categories of intrusive thoughts: self-evaluative, other task-related, and personal thoughts. For each category of thoughts, items were developed to assess intrusive thoughts with either a positive or a negative valence. Listed below are the items, grouped into each of the categories of intrusive thoughts (a copy of the CIQ-R appears at the end of this handout).

Positive Self-Evaluative Thoughts

1. I thought about how confident I was about my answers.
7. I thought about how others would be impressed by my performance.
13. I thought about how I was doing well in the exam.
19. I thought about how I was well prepared.
25. I thought about how easily I could answer the questions.

Negative Self-Evaluative Thoughts

4. I thought about how difficult it was for me to answer the questions.
10. I thought about how I should have been better prepared.
16. I thought about how concerned I was about my answers.
22. I thought about how I was doing poorly in the exam.
28. I thought about how others would be disappointed by my performance.

Positive Other Task-Related Thoughts

5. I thought about how comfortable the room was.
11. I thought about how the questions were interesting.
17. I thought about how there was just the right amount of time for the exam.
23. I thought about how the exam covered an appropriate amount of information.
29. I thought about how I liked the format of the exam.

Negative Other Task-Related Thoughts

2. I thought about how there was too much or too little time for the exam.

8. I thought about how the exam covered an inappropriate amount of information.
14. I thought about how I disliked the format of the exam.
20. I thought about how uncomfortable the room was.
26. I thought about how the questions were boring.

Positive Personal Thoughts

3. I thought about a pleasant interaction I had with someone.
9. I thought about something I did that made someone happy.
15. I thought about a pleasant interaction I am expecting to have with someone.
21. I thought about someone who cares about me.
27. I thought about something someone did that made me happy.

Negative Personal Thoughts

6. I thought about something someone did that upset me.
12. I thought about someone who is upset with me.
18. I thought about something I did that made someone upset.
24. I thought about an unpleasant interaction I had with someone.
30. I thought about an unpleasant interaction I am expecting to have with someone.

Conducting Your Analyses

In order to begin your analyses, you will need to log onto the Citrix server, click on the "SPSS" icon, and call up the following data file: "QLit-03-04.dat". The procedure for doing this is explained in the accompanying handout.

In this assignment, you will encounter several concepts that we have discussed in class as you proceed with your analyses. These include:

- | | |
|---------------|-----------------|
| communalities | factor loadings |
| eigenvalues | factor rotation |
| scree test | |

In order to conduct your analysis, you will need to select a number of options within the SPSS package. To begin your analysis, you will need to click on the "Analyze" menu (see Figure 1); you will then need to slide your mouse to the "Data Reduction" option, and select the "Factor" option.

	subjectn	age	sex	ciqr01	ciqr02
1	260	.	1	4.00	2.00
2	247	18	0	5.00	1.00
3	247	18	0	5.00	1.00

Figure 1

A window will open (see Figure 2).

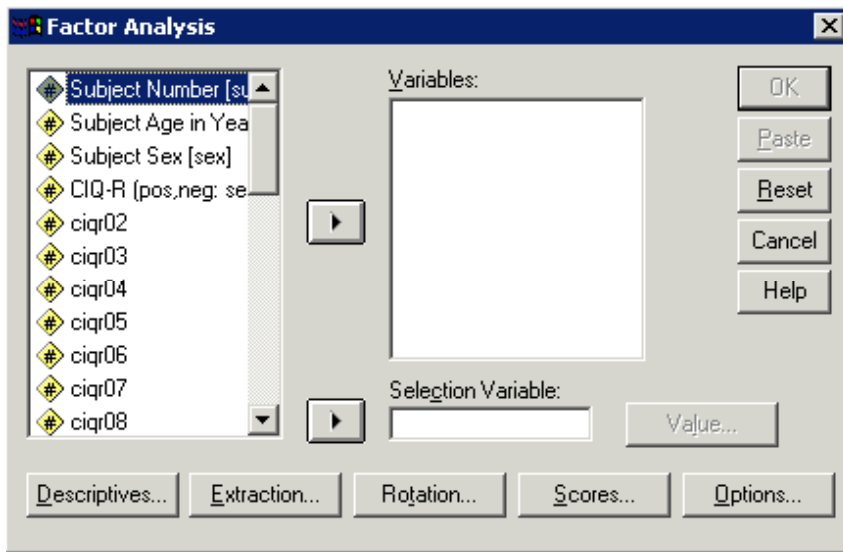



Figure 2

Your first step in the analysis will be to select the set of variables that you intend to use in your factor analysis. To use all of the CIQ-R items, select the first CIQ-R item (labeled 'CIQ-R (pos,neg:')) and scroll down through the remaining items (in the left-hand window) until you come to the last item (which is also labeled 'CIQ-R (pos,neg:'); all of the CIQ-R items should be highlighted in blue. Now click on the arrow option "  " separating the left- and right-hand windows (see Figure 3).

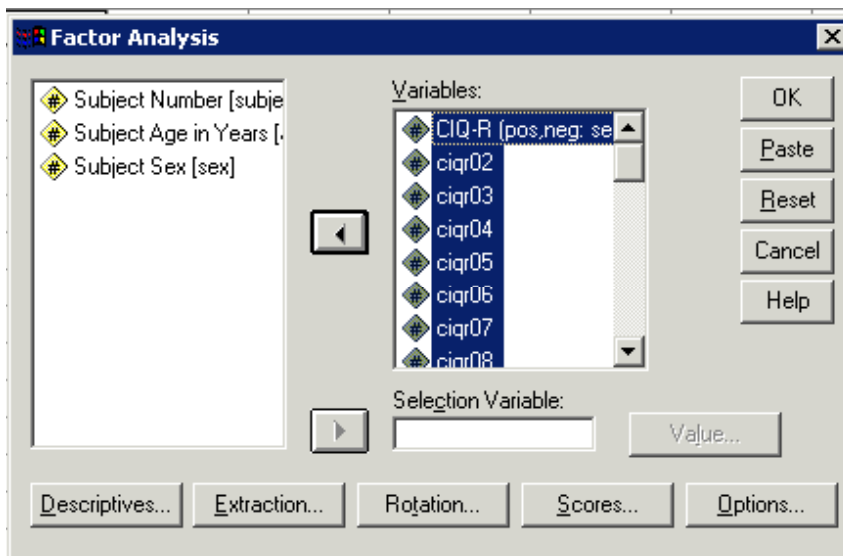


Figure 3

Descriptives

You are now ready to specify several key features of your analysis. By clicking on the "Descriptives" option at the bottom of the window, you can request several useful pieces of information (see Figure 4).

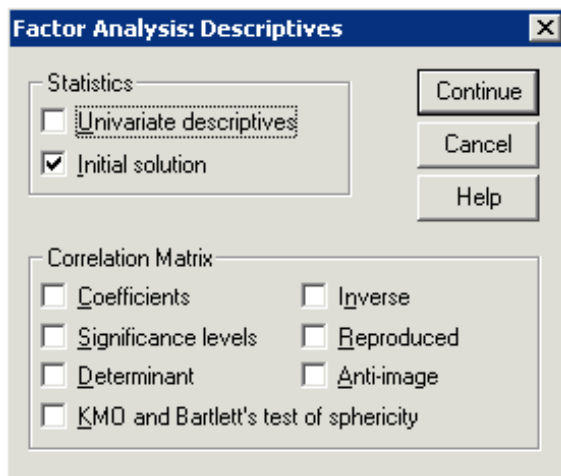


Figure 4

As you can see, there is a 'check' next to the "Initial solution" option under the 'Statistics' features. By clicking on the empty box next to "Univariate descriptives", SPSS will provide you with the mean, standard deviation, and sample size for each of the variables in your factor analysis. To obtain the communality estimates for the variables, click on the "Initial solution" option. Clicking on the "Coefficients" option will allow you to obtain the correlation matrix for all of the variables in the analysis. After selecting the "Descriptives" options that you desire to obtain, click on the "Continue" button and it will return you to the main window for **Factor Analysis** (see Figure 3).

Extraction

You will also want to decide on several aspects to regarding the means by which SPSS will extract factors from your factor analysis. You can do this by clicking on the "Extraction" button in the main window for **Factor Analysis** (see Figure 3). A new window will appear (see Figure 5).

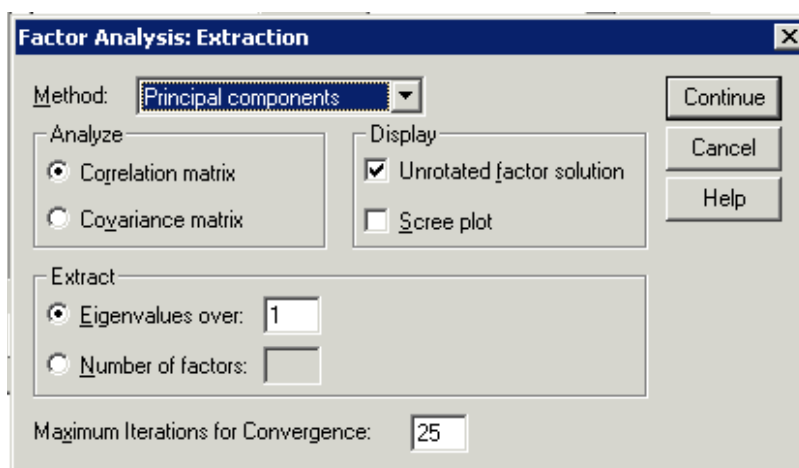


Figure 5

The first decision you will want to make is whether to perform a principal components analysis or a principal factors analysis. Unless you have a specific reason for conducting a principal components analysis, you should perform a

principal factors analysis. SPSS computes a principal components analysis as the default option; to select the principal factors analysis, click on the downward pointing arrow button next to the “**Principal components**” label in the Method window, then pull the cursor down to select the “**Maximum likelihood**” option. Also, unless you have a specific reason for analyzing the covariance matrix, use the default SPSS setting and analyze the correlation matrix (in other words, don’t bother with the options under the **Analyze** portion of the **Extraction** window).

You will also want to decide on how many factors you wish to extract from your analysis. As you may recall, one method for determining the number of factors to examine is to allow as many factors as there are with eigenvalues greater than 1.0. This method for determining the number of factors is, in fact, the SPSS default as you can see from lower portion of the Extraction window (see Figure 5). Another means of deciding on how many factors to examine is simply to run an initial analysis to see how many factors with eigenvalues emerge from the analysis, and also to view a scree plot. You can do this by clicking on the empty box next to the “**scree plot**” option. You may want to unselect the “**Unrotated factor solution**” option.

At this point, you can click on the “**Continue**” button and return to the main window for **Factor Analysis** (see Figure 3). To perform the initial analysis, click on the “**OK**” button. An “**Output**” window will appear that provides results from your initial analysis (see Figure 6).

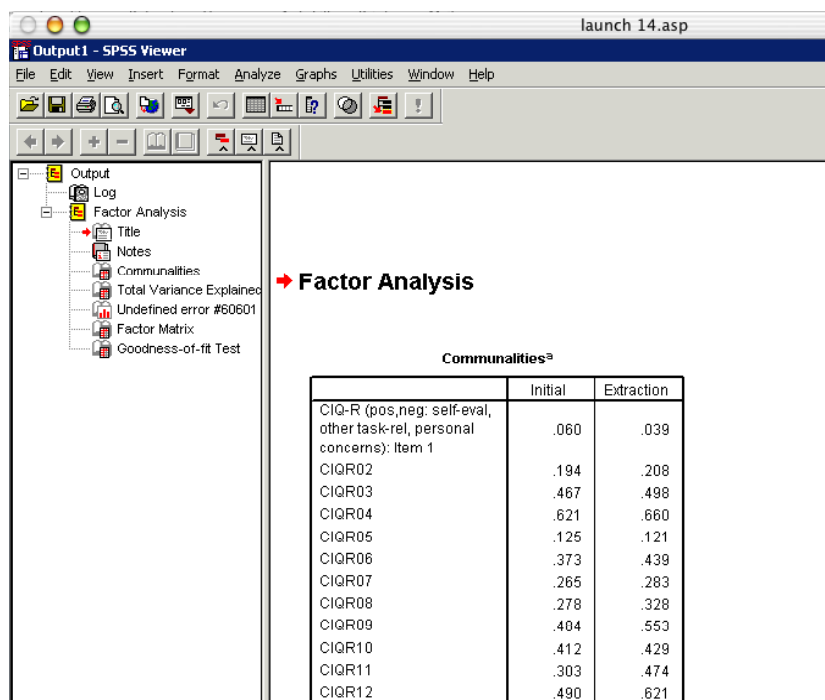


Figure 6

By scrolling down in the window to the section labeled “**Total Variance Explained**”, you can see that with the CIQ-R data, nine factors with eigenvalues greater than 1.0 emerged. You may, based on these results, wish to examine a nine-factor solution for your factor analysis. It may be useful to look at the scree plot to see if it is possible to eliminate some of the factors with eigenvalues greater than 1.0 on the grounds that some of the factors may have arisen from

chance alone. To do this, scroll down in the window until you arrive at the scree plot (see Figure 7). (NOTE: Ignore the "Undefined error #60601" error message).

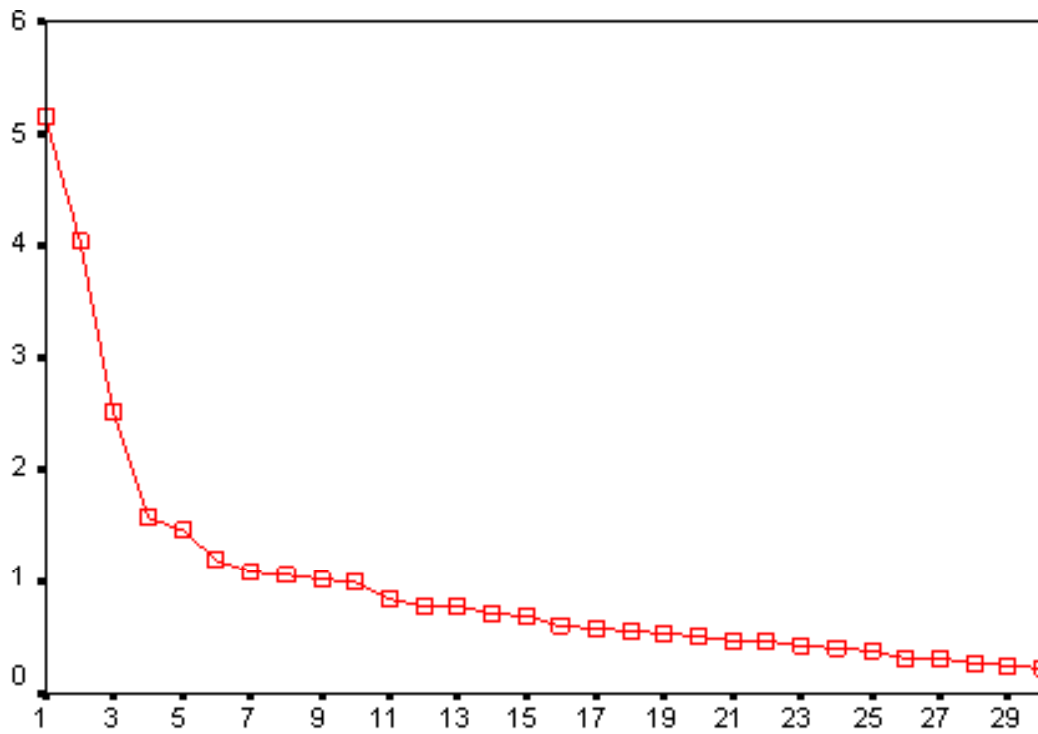


Figure 7

It is often wise to allow the theoretical model that guided the development of your questionnaire to suggest the number of factors that you will examine; in the present case, the researchers proposed six categories of intrusive thoughts. You may therefore elect to examine a six-factor solution. In the interest of being thorough, you may decide to examine each of the possible solutions for eigenvalues greater than 1.0; in this case, it would involve conducting separate factor analyses for a one-factor solution, a two-factor solution, all the way through a nine-factor solution. To instruct SPSS to compute a factor analysis with a specific number of factors, click on the empty circle next to the "Number of factors" option in the **Extraction** window and then type in the number of factors you want to examine into the empty window to the right of this option.

Rotation

To select the method of rotation for the rotated factor solution, click on the "Rotation" button in the main Factor Analysis window (see Figure 3). A new window will appear (see Figure 8).

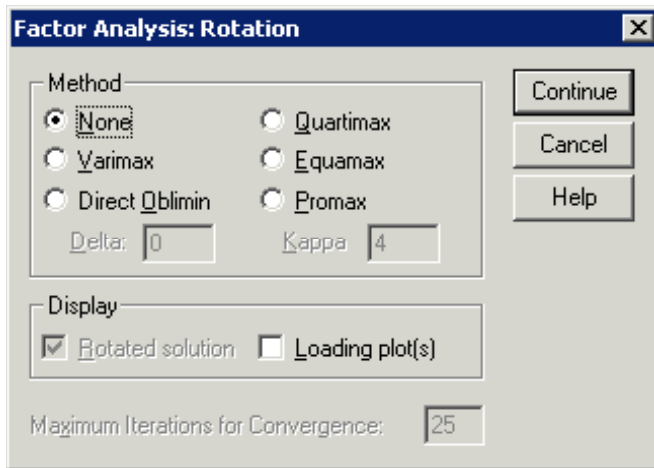


Figure 8

If you want to obtain an oblique solution (i.e., a factor solution with correlated factors), select the “**Direct oblimin**” option. If you want to obtain an orthogonal solution (i.e., a factor solution with uncorrelated factors), select the “**Varimax**” option. After you have selected a method of rotation, you will notice that the “**Rotated solution**” option under the **Display** heading can be modified; leave this setting at its default option, which is to display the rotated factor solution (which you will want to examine).

Factor Scores

SPSS allows you the option of computing factor scores, which for many purposes may be useful, but we will not be dealing with factor scores in any detail in this course; for this reason, you do not need to select the “**Scores**” option in the main Factor Analysis window (see Figure 3).

Other Features

SPSS allows you to define several other features of your analysis and to tailor your output in a manner that you find most useful. Two options that are particularly useful concern the manner in which you want to deal with missing data from your data set and how you want SPSS to format your factor solution tables. To deal with these issues, click on the “**Options**” button in the main **Factor Analysis** window (see Figure 3). A new window will appear (see Figure 9).

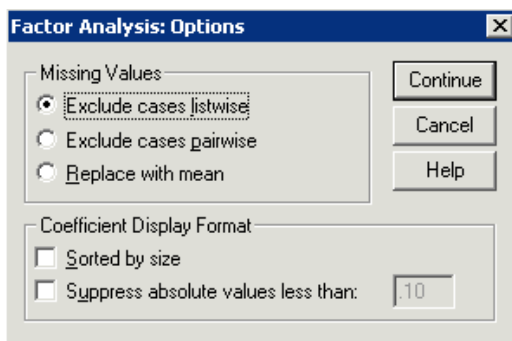


Figure 9

In nearly all data sets generated from actual research, you will find that some data for at least one subject are missing (e.g., at least one subject will fail to complete all of the items on a self-report questionnaire). Unless you have a specific reason for not doing so, allow SPSS to use the default option, "**Exclude cases listwise**", which instructs SPSS to all of the data for any subject for whom there is any missing data for the variables you are using in your factor analysis.

SPSS allows you to control two facets of the printout for the factor solution: the criterion by which variables are listed in the printout, and whether you want to have all of the factor loadings for all variable across all of the factors to appear in the factor solution table. By clicking on the empty box next to the "**Sorted by size**" option, you can request that SPSS organize the factor solution box so that the variables (in this case, items from the CIQ-R) are ordered from top to bottom in the table according to the magnitude of the factor loadings (with variables with the highest factor loading appearing at the top of the table). In addition, you can instruct SPSS delete from the table any factor loadings that are below a specific criterion (e.g., many researchers prefer to examine the factor structure table when only those factor loadings above .30 are reported in the table). To use this option, click on the blank window next to the "**Suppress absolute values less than:**" option and then type in the specific criterion in the window to the right of this option.

Discussion Issues

How are the following pieces of information used to decide on which variables to retain in a factor analysis?

- Variable mean (e.g., floor and ceiling effects)
- Variable standard deviation (e.g., the problem of too little variance)
- Variable commonality estimate (e.g., the problem of too much or too little shared variance)
- Correlations among variables (similar to communality estimates)

How are the following pieces of information used to decide on the number and nature of factors to be retained for a factor solution?

- Eigenvalue associated with each factor (e.g., has a dimension, or simply an item, been identified?)
- Scree plot (to determine spurious factors)
- Factor loadings (to determine what is, and what is not, being identified by each factor)

Age: _____; Gender: **M** **F**

CIQ-r

Instructions: This questionnaire concerns the kinds of thoughts that go through people's heads at particular times, for example, while they are taking an exam. The following is a list of thoughts, some of which you might have had during the exam you have just completed. Please indicate approximately how often each thought occurred to you during your exam by circling the most appropriate letter beside each statement.

-A- Never	-B- Once	-C- A few times	-D- Often	-E- Very Often
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- | | |
|--|-----------|
| 1. I thought about how confident I was about my answers. | A B C D E |
| 2. I thought about how there was too much or too little time for the exam. | A B C D E |
| 3. I thought about a pleasant interaction I had with someone. | A B C D E |
| 4. I thought about how difficult it was for me to answer the questions. | A B C D E |
| 5. I thought about how comfortable the room was. | A B C D E |
| 6. I thought about something someone did that upset me. | A B C D E |
| 7. I thought about how others would be impressed by my performance. | A B C D E |
| 8. I thought about how the exam covered an inappropriate amount of information. | A B C D E |
| 9. I thought about something I did that made someone happy. | A B C D E |
| 10. I thought about how I should have been better prepared. | A B C D E |
| 11. I thought about how the questions were interesting. | A B C D E |
| 12. I thought about someone who is upset with me. | A B C D E |
| 13. I thought about how I was doing well in the exam. | A B C D E |
| 14. I thought about how I disliked the format of the exam. | A B C D E |
| 15. I thought about a pleasant interaction I am expecting to have with someone. | A B C D E |
| 16. I thought about how concerned I was about my answers. | A B C D E |
| 17. I thought about how there was just the right amount of time for the exam. | A B C D E |
| 18. I thought about something I did that made someone upset. | A B C D E |
| 19. I thought about how I was well prepared. | A B C D E |
| 20. I thought about how uncomfortable the room was. | A B C D E |
| 21. I thought about someone who cares about me. | A B C D E |
| 22. I thought about how I was doing poorly in the exam. | A B C D E |
| 23. I thought about how the exam covered an appropriate amount of information. | A B C D E |
| 24. I thought about an unpleasant interaction I had with someone. | A B C D E |
| 25. I thought about how easily I could answer the questions. | A B C D E |
| 26. I thought about how the questions were boring. | A B C D E |
| 27. I thought about something someone did that made me happy. | A B C D E |
| 28. I thought about how others would be disappointed by my performance. | A B C D E |
| 29. I thought about how I liked the format of the exam. | A B C D E |
| 30. I thought about an unpleasant interaction I am expecting to have with someone. | A B C D E |