

## **CHAPTER 11: CONFIRMATORY FACTOR ANALYSIS AND STRUCTURAL EQUATION MODELS**

We provide here the LISREL SIMPLIS syntax files required for running the examples.

Data used in this chapter are provided in ASCII (\*.dat) format. The data files (input files) are ready for carrying out the analysis with the LATCLASS program to be found in the LAMI interface.

We also give the output files in ASCII (\*.out) of the analysis performed with the LATCLASS program.

A free student version of LISREL can be downloaded from  
<http://www.ssicentral.com/lisrel/downloads.html>

### **Subjects marks data**

The data are pairwise correlation coefficients between subject scores for a sample of 220 boys. The correlation matrix is included in the syntax file.

The subject scores are in the following order: Gaelic, English, History, Arithmetic, Algebra, Geometry.

Syntax for reading the correlation matrix and carrying out a confirmatory factor analysis is given in subjectA.spj for obtaining the standardized solution and in subjectB.spj for obtaining the unstandardized solution.

The output of the standardized and unstandardized solution are given in SUBJECTSA.OUT and SUBJECTSB.OUT respectively.

### **Ability data**

The data come from the Educational Testing Service in the United States and refer to a nationwide sample in 1963 and 1965 corresponding to seventh and ninth graders respectively. The observed variables are scores from the verbal (SCATV) and quantitative (SCATQ) parts of the Scholastic Aptitude Test (SCAT) and achievement tests in mathematics (MATH), science (SCI), social studies (SS), listening, (LIST), writing (WRIT) and reading (READ). We analyse here the group of Academic girls in grades 7 and 9.

Two structural equation models have been fitted to analyze the data. The syntax files are given in abilityA.spj and abilityB.spj. The LISREL system file with the description of the data and the correlation matrix is given in file ability.dsf.

The corresponding outputs are given in abilityA.out and abilityB.out.

## Test Anxiety Inventory

This example is based on data from the test anxiety inventory, which is used to assess overall anxiety associated with taking tests. The inventory has been used in many countries, with similar results. The data analysed here consists of a test with 20 items given to 335 male grade 12 students in British Columbia.

Students were asked to report how frequently they experienced various symptoms of anxiety in taking tests. A brief description of the items is given below.

Lack of confidence during tests  
Uneasy, upset feeling  
Thinking about grades  
Freeze up  
Thinking about getting through school  
The harder I work, the more confused I get  
Thoughts interfere with concentration  
Jittery when taking tests  
Even when prepared, get nervous  
Uneasy before getting the test back  
Tense during test  
Exams bother me  
Tense/ stomach upset  
Defeat myself during tests  
Panicky during tests  
Worry before important tests  
Think about failing  
Heart beating fast during tests  
Can't stop worrying  
Nervous during test, forget facts

Syntax for reading the correlation matrix from file anxiety.cor and carrying out a confirmatory factor analysis is given in anxiety.spj.

The output of the analysis is given ANXIETY.OUT.

## The Green consumer data

The sample consists of 330 university students in Greece. The aim of the study was to identify the factors that affect willingness to pay more for environmentally friendly products.

### Variables:

1. Poisonous metals (e.g. mercury, cadmium) are introduced into the food chain through ground water. [KN\_EN2]
2. Ozone near the ground may cause respiration problems. [KN\_EN3]
3. Air pollution is mainly caused by cars. [KN\_EN4]
4. Batteries cause severe soil pollution. [KN\_EN7]
5. Mobile phones when discarded are very dangerous for the environment. [KN\_EN8]
6. Chlorine is one of the most harmful substances for the water environment. [KN\_EN5]
7. Washing powder and especially fabric softener contribute significantly to the degradation of maritime ecosystems. [KN\_EN6]
8. I prefer to buy products in recyclable packaging. [PUR1]
9. I avoid buying products in aerosol containers (e.g. hair spray). [PUR3]
10. I purchase light bulbs that are more expensive than ordinary ones but save energy. [PUR4]
11. I purchase the lowest priced product without examining its impact on the environment. [PUR5]
12. I switch products for ecological reasons. [PUR6]
13. I try to use the least possible amount of water when I do household cleaning. [CONS1]
14. I try to cut down on electrical consumption in my household. [CONS2]
15. I try to use the least possible amount of paper. [CONS3]
16. I try to use the least possible amount of cleaning supplies. [CONS4]
17. Tick the product categories which you recycle regularly. (Batteries, Plastic containers, Mobile phones, Metal containers - tins, Paper, Glass) [REC]
18. I would pay 10\% more for groceries that are processed and packaged in an environmentally friendly way. [WIL1]
19. I am willing to spend an extra 10 euro a week in order to buy less environmentally harmful products. [WIL2]

Items 1 through 7 and items 18 and 19 were scored on a five-point scale: 1=agree strongly, 2=agree, 3=neither agree nor disagree, 4=disagree, 5=disagree strongly.

Items 8 through 16 also used five point scales from 1=Always to 5=Never, except for item 11 where the scoring was reversed. Item 17 was scored by counting the number of products recycled regularly (from 0 to 6).

The LISREL simplis syntax file is given in green\_consumer.spj.

The correlation matrix is given in file envr.pm.

The asymptotic covariance matrix is given in file envr.acp

The output of the analysis is given in green\_consumer.out