**Exercises with MPLUS (1)**

**Introduction to the logic and use of Mplus**

Open the file Mplus\_template.inp. The file shows an empty template of basic Mplus commands.

Important features:

**;**

* Every command ends with a semi-colon.
* A Comment is marked with an exclamation mark.

**!**

* The syntax is NOT case sensitive.
* Variable names can have a maximum length of 8 characters.
* The length of each command line is limited to 80 characters; one command may cover more than one line and ends with the next semi-colon.
* Overview of the whole Mplus language see Version 7 User’s Guide, Ch.20, p. 805ff.
* There are Commands (e.g. MODEL), Options (e.g. ESTIMATOR) and Keywords (e.g. BY)

# EXPORTING DATA TO MPLUS

## With SPSS

Before exporting data to a tab-delineated (ASCII) file you have 2 options dealing with MISSINGS in your data.

1. Recode the missing values beforehand into an unmistakable numeric value which you can define in Mplus as well (you can define several values as missing). Here is an example for the SPSS-syntax (the value used is arbitrary):

RECODE variable01 variable02 variable03 variable04 (e.g. SYSMIS=-9999).

1. Or you can define "." in the Mplus syntax as missing (in the variable command) afterwards and keep missings marked as such. As a consequence you cannot define any other value as missing.

### Creating an ASCII-file:

1. use drop-down menus
   1. save data as …
   2. select desired variables
   3. deselect option to have variable names in first row
   4. choose desired data format (.dat, .txt)
2. use following syntax command:

SAVE TRANSLATE OUTFILE='C:\>your path<\xxx.dat'  
/TYPE=TAB  
/MAP  
/REPLACE  
/CELLS=VALUES  
/TEXTOPTIONS DECIMAL= DOT  
/KEEP=>variable01 variable02 variable03 variable04<.

### With STATA

Use the programme stata2mplus (download at http://www.ats.ucla.edu/stat/stata/faq/stata2mplus.htm)

### Creating a correlation matrix with SPSS

CORRELATIONS

/variables = >variable01 variable02 variable03 variable04<

/MISSING=LISTWISE

/matrix=out(\*).

### Using covariance/correlation matrizes

Title: covariance (or: correlation) matrix;

data: file = >1997.dat<;

type = covariance ; ! (type = mean std correlation;)

nobs = >660<;

…

[the correlation/covariance triangle should first list means, then the std and at last the correlation matrix]

## TRANSFORM DATA

1. Create a .dat-file from the ess3at.sav with the variables *ipmodst imptrad ipfrule ipbhprp ipeqopt ipudrst impenv imsmetn imdfetn impcntr* and name it ess3at\_TRACO\_UNIV\_ATT.dat.
2. Your total sample size should be N=2405; you ought to have 10 columns.
3. Missing values are 7-9.
4. Run a *type=basic* model
   1. insert the correct name of the data-file
   2. insert the variable names
   3. add the option *type=basic* in the ANALYSIS command
   4. Demand *sampstat* in the OUTPUT-command
5. Which output-segments does the *type=basic* option yield?

# CONFIRMATORY FACTOR ANALYSIS

The examples are based on the concept of basic human values as described by Shalom Schwartz and used in the European Social Survey (short: ESS) in an abbreviated version fit for an already extensive questionnaire: the Portrait Values Questionnaire (PVQ). The ESS is a cross-national and cross-sectional instrument which is biennially asked in samples of the general public of a majority of the states belonging to the European Union and is thus used extensively. There is broad research on the validity and reliability of its measures.

In the social sciences values are seen in the psychological make-up of the human mind as one of its fundamental parts influencing other psychological concepts like attitudes (Hitlin and Piliavin 2004; Judd and Krosnick 1982)⁠ which again are related to actions (see Ajzen 1991). For a conceptional understanding between the difference of values and attitudes we refer to Davidov et al. (2008: 584)⁠ . Schwartz' value conception focuses on the explanation of altruistic and pro-social behavior (see Bamberg and Schmidt 2010)⁠ and also its opposing sides.

The basic research question derived from applied research which guides the following exercises is: How do values related to traditional and conformity beliefs influence the perception of migrants in different countries?

The link between welcoming or opposing migrants in a country (attitude towards migrants) and a pertaining level of conservational values (traditionalism and conformity) is derived from the following quote: “*[…]* *human values whose motivational goals are promoted or blocked by the arrival of immigrants will affect attitudes toward immigration.”* (Davidov et al. 2008: 585).

The following examples will introduce stepwise the operationalization of that research question. Foremost, we have to begin by examining the presuppositions in the question:

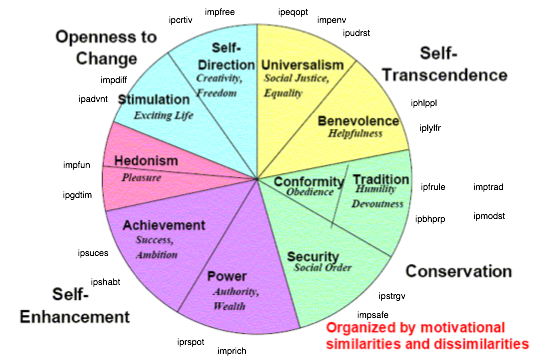
1. Is there a valid measurement for our concepts?
2. Are these concepts measured similarly in countries?

# What is the measurement structure?

Data file: ess3at\_TRACO\_UNIV\_ATT.dat

The set of variables contain several measurement models.

* 1. How many latent (unobserved) constructs can you identify among the items in the data-set belonging to human values? Figure Figure

 Figure 1: Dynamic structure of human values according to Sh. Schwartz

* 1. Which indicators would you use respectively?
  2. How would you name the construct for the remaining three items?

# Confirmatory factor Analysis with one factor and four indicators.

Data file: ess3at\_TRACO\_UNIV\_ATT.dat

 Figure 2: Measurement model TRACO

* 1. *ipmodst imptrad ipfrule ipbhprp* *ipeqopt ipudrst impenv imsmetn imdfetn impcntr* are the variables of the data file. Build an Mplus-template and convert the path diagram of Figure into Mplus syntax.

Use in the ANALYSIS-command the following option:

model=nomeanstructure;   
information=expected;

* + 1. The estimator by default is ML/FIML. Are the according assumptions met by our data? Which alternative should we consider (Add ANALYSIS-option *estimator=<xxx>)*?
    2. Which are the unknown parameters in your model?
    3. How many are there?
    4. How much information is there in the var/covar-matrix?
    5. How did you calculate this number?
    6. How many positive/negative degrees of freedom do we have?
    7. To which extend is our model identified (under-, over- or just identified)?
  1. Make a “map” of the output and get a sense of where you find information on the estimation, the data, sample statistics, estimates, standardized estimates, etc. It will be usefull for future analysis to know where to find the respective information. We recommend you use this as template to add future (and also past) knowledge acquired during the theoretical input and discussions.

INTERMEZZO: Freeing, fixing and constraining parameters (see Mplus User Guide, Chapter “Model Command” for specific use of options and keywords)

* + 1. To **free a parameter** that is constrained by default put an asterisk >\*< after it. E.g. to free the first factor loading (What does this mean for the second factor loading?).
    2. To **fix a parameter to a certain value** put >@< and the value you choose after it. E.g. to constrain the variance of the latent variable write.

F1 BY v1@1.0;

* + 1. To **constrain a set of parameters to be equal** put a character in parenthesis after them. E.g. to constrain the third and the fourth factor loading to be equal write:

TRACO by ipfrule (1);  
TRACO by ipbhprp (1);

* 1. Try to estimate all factor loadings freely, constrain the variance of the latent variable to 1.

## Tau-equivalent measurement model

data file: ess3at\_TRACO\_UNIV\_ATT.dat

Tau-equivalent is the name for a certain configuration (loadings constrained to be equal). This exercise introduces the application for this concept. The main idea here is to learn how to use restrictions and how they affect our outcomes.

* 1. Try to estimate a tau-equivalent model with variables *ipmodst imptrad ipfrule ipbhprp* by constraining the four factor loadings to be equal.
  2. Before you let Mplus do all the work: How many parameters does this model have? How many elements are there in the variance-covariance matrix? How many degrees of freedom will the model yield? Will this model be more easily or less easily falsified than the parent model? Find arguments for your case!
  3. Which estimate is affected by this constraint: the standardized or unstandardized solution?
  4. Why is only one solution different?
  5. How many degrees of freedom does this model have?
  6. How would you consider the overall model fit? Did it improve compared with the parent model?
  7. Which statistical test would tell us whether we should reject or endorse the new model?
  8. Conceptional exercise: Name three reasons why we would want to constrain parameters

## Parallel measurement model

* 1. Build on the exercise before and try to estimate a parallel model by constraining the factor loadings and the measurement error variances to be equal.
  2. Before you let Mplus do all the work: How many parameters does this model have? How many elements are there in the variance-covariance matrix? How many degrees of freedom will the model yield?
  3. Do we want to have degrees of freedom at all? Are more or less DF interesting from the perspective of theory of science? Find arguments for your case!

# Simultaneous Confirmatory Factor Analysis (SCFA)

Data file: ess3at\_TRACO\_UNIV\_ATT.dat

 Figure 3: SCFA with UNIV, TRACO and ATT

* 1. Set up the Mplus code for a model with 3 latent factors as depicted in Figure 3.   
     Covariances are specified with the keyword WITH.
  2. Do you really need to specify the covariances among the latent variables? What are the default settings of Mplus?
  3. How well does this model fit to the data?
     1. What about global model fit?
     2. What about detailed model fit?
     3. Are there any “local areas of strain”, i.e. parts of the model that do not fit? (Check the factor loadings and standardized residuals).

# Bibliography

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