**Scale Construction: A Manual**

This text is a brief summary to supplement the slides of the lectures. You may consult it in the future whenever you need to make a scale and you can use it as a guideline to make the bonus assignment. These notes only treat the analysis of questionnaire data; hence it is assumed that you have already administered your questionnaire and entered the data into SPSS. This note clarifies is the following question:

> *"How do I create one or multiple scales that account for the respondent characteristics (this is, the underlying constructs) that underlie the responses given to the questionnaire items (hence, the questionnaire data)?"*

The first step is to perform an exploratory analysis, that is, you do not have strong expectations about how many factors there are and about which items belong to which factor. In case you would have strong expectations, than confirmatory factor analysis is the appropriate technique.

The procedure to follow in order to answer the above question (printed in italics) is the following:

**Exploratory scale construction: the complete procedure**

(i) Is the relation between items linear?
(ii) First FA: Does FA make sense and how many factors / components to choose?
(iii) Second FA: Varimax
(iv) Third FA: Oblimin
(v) Select a solution from the results obtained in steps (iii) and (iv) + interpretation thereof
(vi) Calculate the sum scores for the (sub)constructs
The resulting scales have to be checked using the five rules for controling the reliability and validity of a scale
(vii) Evaluate the scale and report Cronbach $\alpha$ (See Manual Reliability.doc)

What follows is a brief explanation of the procedure.

The first difficulty you encounter in step (ii) is the determination of the number of components. More often than not, it is not immediately clear how many components you should choose. The larger-than-one rule is a clear rule but often indicates too much components. The Scree plot is better in this sense but does not always give an unequivocal answer to the following question: How many dots clearly fall above the line you draw? If it is unclear how many components you have to choose, then perform several Fas/PCAs, each with a different number of components. In the end you choose from all these possible

results, for example based on interpretation. Sometimes you have to perform all these different analyses (based on a different number of components) upto including step (vii) before you can make your choice. Your final choice should be supported by a clear and sensible interpretation and having scales with a Cronbach's alpha that is at least equal to 0.6.

**The following rules and questions will help you during the analyses**:

• After rotation, does each component have at least three items with a high loading on the component? If the answer is no, then you have to select a solution with fewer components because a scale with less than 3 items is rarely a good and appropriate scale.

• If there is an item that belongs to no scale (all loadings of the item, in absolute value, <0.3), remove this item and then do the analysis again. This is an item not belonging to any of the scales.

• If a set of items is too small (less than 3 items) or this set yields a scale with an insufficient reliability (alpha clearly smaller than 0.6, or multiple items with low contribution to reliability), then do not make a scale with these items.

• If there is an item in step (vii) that does not belong to any scale, discard the item and redo the reliability analysis as it may appear that a next (and a third, …) item has to be discarded. However, do not remove more than one item simultaneously from a scale, you have to do this step by step.

• What to do with items that, from the results obtained in step (iv), appear to be associated with multiple components? There are a number of options. The best procedure is the following one: If the item clearly has a much higher loading on one component, then add the item to that component. If the item loads similarly on multiple components, then you have to check whether it contributes to a scale (using step [vii]). If it does not fit any scale, remove it. If it fits only one of the scales, the problem is solved. If it fits multiple scales, add it to the scale with the least number of items. In the end, you may attribute the item to only one scale!

• And ... do not forget to reverse items before you perform step (vi) and (vii)!