Measurement in the Social Sciences (TT 2007)
Appendix 1.2: Reliability Extended Examples - SPSS

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1 Good Uni-dimensional Scale

Table 1: Variables used in the analysis (nes04.dta)

spendserv	Spending and Services -7-point scale self-placement
defspend	Defense spending - 7-point scale self-placement
insurance	Govt/private medical insurance scale: self-placement
jobsliv	Job and Good Standard of Living -scale self-placement
gablacks	Government assistance to blacks-7 point scale self-placement
envjobs	Environment vs. jobs tradeoff scale - self-placement
fedgun	Should fed govt make more difficult to buy gun - self-placement
womrole	Women's role - 7-point self-placement

The first step in the process is to take a look at the correlation matrix of these variables. We can get this in SPSS by doing the following: Analyze ⇒ Correlate ⇒ Bivariate. Click on the variables you want and move them to the "Variables" window by using the ▶ key.[1]

[1] You can change from listwise delete to pairwise delete in the options dialog box.

Correlations

		N1a. Spending and Services - 7-point scale self-placement	N2a. Defense spending - 7-point scale self-placement	N4a. Govt/private medical insurance scale: self-placement	N5a. Job and Good Standard of Living -scale self-placement	N6a. Government assistance to blacks-7 point scale self-pl	P3a. Environment vs. jobs tradeoff scale - self-placement	P5a. Should fed govt make more difficult to buy gun - self	P6a. Women's role - 7-point scale self-placement
N1a. Spending and Services - 7-point scale self-placement	Pearson Correlation	1	.164	.422	.405	.294	.209	.180	.134
	Sig. (2-tailed)		.000	.000	.000	.000	.000	.000	.000
	N	1060	965	1004	984	970	933	1054	1035
N2a. Defense spending - 7-point scale self-placement	Pearson Correlation	.164	1	.258	.245	.249	.203	.201	.112
	Sig. (2-tailed)	.000		.000	.000	.000	.000	.000	.000
	N	965	1061	996	990	970	940	1055	1027
N4a. Govt/private medical insurance scale: self-placement	Pearson Correlation	.422	.258	1	.497	.287	.225	.170	.161
	Sig. (2-tailed)	.000	.000		.000	.000	.000	.000	.000
	N	1004	996	1112	1032	1011	965	1105	1081
N5a. Job and Good Standard of Living -scale self-placement	Pearson Correlation	.405	.245	.497	1	.510	.206	.172	.125
	Sig. (2-tailed)	.000	.000	.000		.000	.000	.000	.000
	N	984	990	1032	1103	999	959	1096	1069
N6a. Government assistance to blacks-7 point scale self-pl	Pearson Correlation	.294	.249	.287	.510	1	.183	.161	.133
	Sig. (2-tailed)	.000	.000	.000	.000		.000	.000	.000
	N	970	970	1011	999	1073	928	1067	1041
P3a. Environment vs. jobs tradeoff scale - self-placement	Pearson Correlation	.209	.203	.225	.206	.183	1	.097	.203
	Sig. (2-tailed)	.000	.000	.000	.000	.000		.002	.000
	N	933	940	965	959	928	1019	1013	993
P5a. Should fed govt make more difficult to buy gun - self	Pearson Correlation	.180	.201	.170	.172	.161	.097	1	.129
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.002		.000
	N	1054	1055	1105	1096	1067	1013	1202	1148
P6a. Women's role - 7-point scale self-placement	Pearson Correlation	.134	.112	.161	.125	.133	.203	.129	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	
	N	1035	1027	1081	1069	1041	993	1148	1157

You can see that the correlations generally range from .15 to .5 in absolute value. The only variable that looks like it may not belong is women's role as it has a number of relatively small correlations. This is something to keep in mind as we continue, but it is not evidence to exclude this variable now. Another thing to notice is that the spending and services seems to be negatively correlated with everything else, so we will want to look at the question wording and then if the question is worded in the opposite direction, we will turn reverse this item in the scale. Now, it probably makes sense to generate standardized variables which can be done through Analyze ⇒ Descriptive Statistics ⇒ Descriptives. Then, click the variables you want to be standardized into the box and tick the box for "save standardized values as variables".

Now, we can perform the reliability anaylsis the following way: Analyze ⇒ Scale ⇒ Reliability Analysis. Then, click on the variables you want to use and move them to the variables window. In the "Model" pulldown menu, make sure Alpha is selected. Then click the "Statistics" button and tick all the boxes in "Descriptives for", then tick the "correlations" box under inter-item and then click the continue button. You are especially interested in the "Item-Total Statistics", which should look like this.
Notice that α is relatively high. Here, we are asked to make a judgement call about whether to remove an item to get a very little bit higher reliability. Alpha doesn't come with a significance test or confidence interval, but you could create one with a technique called bootstrapping.[2] Unfortunately, I'm not sure how one would go about doing this in

[2]Bootstrapping draws a sample *with replacement* of length n (where n is the number of observations

Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Zscore: N1a. Spending and Services - 7-point scale self-placement	.1086752	16.552	.516	.316	.689
Zscore: N2a. Defense spending - 7-point scale self-placement	.2233877	17.775	.381	.163	.717
Zscore: N4a. Govt/private medical insurance scale: self-placement	.1504557	16.478	.553	.363	.682
Zscore: N5a. Job and Good Standard of Living -scale self-placement	.1131371	16.452	.572	.424	.679
Zscore: N6a. Government assistance to blacks-7 point scale self-pl	.1822454	17.226	.473	.283	.699
Zscore: P3a. Environment vs. jobs tradeoff scale - self-placement	.1836275	17.957	.350	.138	.723
Zscore: P5a. Should fed govt make more difficult to buy gun - self	.1769272	18.328	.305	.108	.732
Zscore: P6a. Women's role - 7-point scale self-placement	.1902740	18.603	.284	.098	.735

SPSS (not that it is impossible, but it is well beyond my SPSS knowledge. If interested, please see the Stata handout.
This gives a 95% confidence interval for α of [0.72, 0.78]. So, we can use this information to evaluate the results from the `alpha` command. Since we could not get a *significantly* better α by dropping a variable, I suggest that we leave all of them in for right now.

Now, it is probably worth trying to address the monotone homogeneity assumption. For this, like I said before you can plot each variable in turn against its rest score. The graph that I'm talking about is called a "Lowess" graph, which stands for Locally Weighted Scatterplot Smoother. Essentially, this technique fits a smooth line to a scatterplot. There is no assumption that the line has to take any particular form, so non-monotonicity is a possibility. If we see this in the graphs, that is evidence that the included item does not belong in the scale. The SPSS syntax would look something like:

in the dataset) and computes a sample statistic for each of what is usually between 1000 and 2500 iterations. So, Stata draws a sample of 749 with replacement from the valid cases, then calculates α, then draws a new sample with replacement and does this again. The result is an empirical confidence interval for the sample statistic.

```
COMPUTE rest1 = Zdefspend+Zinsurance+Zjobsliv+Zgablacks+Zenvjobs+Zfedgun +Zwomrole .
COMPUTE rest2 = Zspendserv +Zinsurance+Zjobsliv+Zgablacks+Zenvjobs+Zfedgun +Zwomrole .
COMPUTE rest3 = Zspendserv + Zdefspend+Zjobsliv+Zgablacks+Zenvjobs+Zfedgun +Zwomrole .
COMPUTE rest4 = Zspendserv + Zdefspend+Zinsurance+Zgablacks+Zenvjobs+Zfedgun +Zwomrole .
COMPUTE rest5 = Zspendserv + Zdefspend+Zinsurance+Zjobsliv+Zenvjobs+Zfedgun +Zwomrole .
COMPUTE rest6 = Zspendserv + Zdefspend+Zinsurance+Zjobsliv+Zgablacks+Zfedgun +Zwomrole .
COMPUTE rest7 = Zspendserv + Zdefspend+Zinsurance+Zjobsliv+Zgablacks+Zenvjobs+Zwomrole .
COMPUTE rest8 = Zspendserv + Zdefspend+Zinsurance+Zjobsliv+Zgablacks+Zenvjobs+Zfedgun .

GRAPH
  /SCATTERPLOT(BIVAR)=rest1 WITH Zspendserv
  /MISSING=LISTWISE
  /TEMPLATE='C:\Documents and Settings\david.armstrong\Desktop\gtemp.sgt'.
GRAPH
  /SCATTERPLOT(BIVAR)=rest2 WITH Zdefspend
  /MISSING=LISTWISE
  /TEMPLATE='C:\Documents and Settings\david.armstrong\Desktop\gtemp.sgt'.
GRAPH
  /SCATTERPLOT(BIVAR)=rest3 WITH Zinsurance
  /MISSING=LISTWISE
  /TEMPLATE='C:\Documents and Settings\david.armstrong\Desktop\gtemp.sgt'.
GRAPH
  /SCATTERPLOT(BIVAR)=rest4 WITH Zjobsliv
  /MISSING=LISTWISE
  /TEMPLATE='C:\Documents and Settings\david.armstrong\Desktop\gtemp.sgt'.
GRAPH
  /SCATTERPLOT(BIVAR)=rest5 WITH Zgablacks
  /MISSING=LISTWISE
  /TEMPLATE='C:\Documents and Settings\david.armstrong\Desktop\gtemp.sgt'.
GRAPH
  /SCATTERPLOT(BIVAR)=rest6 WITH Zenvjobs
  /MISSING=LISTWISE
  /TEMPLATE='C:\Documents and Settings\david.armstrong\Desktop\gtemp.sgt'.
GRAPH
  /SCATTERPLOT(BIVAR)=rest7 WITH Zfedgun
  /MISSING=LISTWISE
  /TEMPLATE='C:\Documents and Settings\david.armstrong\Desktop\gtemp.sgt'.
GRAPH
  /SCATTERPLOT(BIVAR)=rest8 WITH Zwomrole
  /MISSING=LISTWISE
  /TEMPLATE='C:\Documents and Settings\david.armstrong\Desktop\gtemp.sgt'.
```

What you can see here is that for the most part, the plots are all monotonic with respect to the rest-scale. The places where this may not be true are `insurance`, `womrole` and `fedgun`, where the plot goes down very slightly first then up. It's not obvious whether these are sample anomalies or real violations of the assumptions. You could make a case

either way. I would probably leave these variables in, however you could reasonably justify doing otherwise.

If we're confident that we have the "right" model, that is that there is evidence in support of the assumptions of the model, then we are left with the task of interpretation. One thing that is simultaneously good and bad about scaling solutions is that they do not interpret themselves. Once we develop a scale, it is up to the researcher to assign it a name and interpretation. This scale should work as a reasonable measure of political ideology in the US in 2004. Given that the ANES asks a question about liberal-conservative self-placement on a 7-point scale, this new measure should correlate relatively highly with the liberal-conservative variable. If we take liberal-conservative placement as the "true" dimension (which it is not), we should see higher correlations between the liberal-conservative placement and the scale than any of the individual variables.

Table 2: Correlations of the scale and individual items with liberal-conservative self-placement

Variable	Liberal-Conservative
Scale	0.640
Spending and services	−0.443
Defense spending	0.382
Private vs. govt health insurance	0.455
Jobs vs. standard of living	0.451
Govt aid to blacks	0.384
Environment vs. jobs	0.340
Easier to buy a gun	0.334
Woman's role	0.327

We will never know the true dimension, but it is interesting that the scale correlates higher with liberal-conservative self-placement than any of the other variables that might be used to measure the same concept. This is strictly a pedagogical exercise. It is nice that the scale correlates with ideological self-placement, but we should not suggest that it represents the true dimension.

1.1 Generating the Variable

Once you have the scale you want, you'll also want to generate the scale variable that is an estimate of the underlying dimension. To do this, you can ask SPSS to compute a new variable for you that is the sum of the observed variables in the scale. Here, SPSS will only listwise delete, so if you have an observation with one piece of information missing, it will be excluded from the scale. If this seems reasonable, you can doe the following:

```
COMPUTE Scale = Mean(Zspendserv TO Zwomrole).
EXECUTE.
```

However, you might want to use some of that information for individuals who have some/most of the information there. You can do this in the following way:

```
COMPUTE NMiss = MISSING(Zspendserv) + MISSING(Zdefspend) + MISSING(Zinsurance) +
    MISSING(Zjobsliv) + MISSING(Zgablacks) + MISSING(Zenvjobs) +
    MISSING(Zfedgun) + MISSING(Zwomrole).
EXECUTE.

COMPUTE Zspendservnm = Zspendserv.
COMPUTE Zdefspendnm = Zdefspend.
COMPUTE Zinsurancenm = Zinsurance.
COMPUTE Zjobslivnm = Zjobsliv.
COMPUTE Zgablacksnm = Zgablacks.
COMPUTE Zenvjobsnm = Zenvjobs.
COMPUTE Zfedgunnm = Zfedgun.
COMPUTE Zwomrolenm = Zwomrole.
EXECUTE.

RECODE Zspendservnm TO Zwomrolenm (MISSING=0).
EXECUTE.

COMPUTE scale = SUM(Zspendservnm TO Zwomrolenm)/(8-NMiss).
EXECUTE.
```

Now, you've got the opposite problem where everyone with at least one valid response has a scale score. We may want to make it so that only people with a certain amount of non-missing information have a scale score. This can be done the following way:

```
DO IF (NMiss > 4) .
RECODE
  scale  (ELSE=SYSMIS)  .
END IF .
EXECUTE .
```