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KUANT Guides

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KUANT 004.2

Starting Values in LISREL:

Using start values to obtain model convergence.

Geldhof, G.J., Selig, J.P. & McConnell, E.K. (2008)

Why Use Starting Values?

LISREL normally uses two-stage least squares to calculate starting values (initial parameter estimates). These estimates form the base from which the maximum likelihood algorithm begins its iterations. Sometimes these estimates lead to an initial covariance matrix that is not positive definite. When this is the case, better starting values must be provided to LISREL in order to obtain model convergence.

Setting Start Values: the ST and MA Commands

1. The ST Command

The following syntax tells LISREL that a user-provided parameter estimate should be used when starting the maximum likelihood iterations:

ST<value> <parameters>

Individual parameters: This command can be used to provide starting values for one or more individual parameters: **ST .7 PS(2,1) PS(3,1)**
The user is telling LISREL to start PS(2,1) and PS(3,1) at the value of .7

Universal starting value: Additionally, a user can provide a universal starting value: **ST .7 ALL**
Here, the user is telling LISREL to start all freely estimate parameters at .7

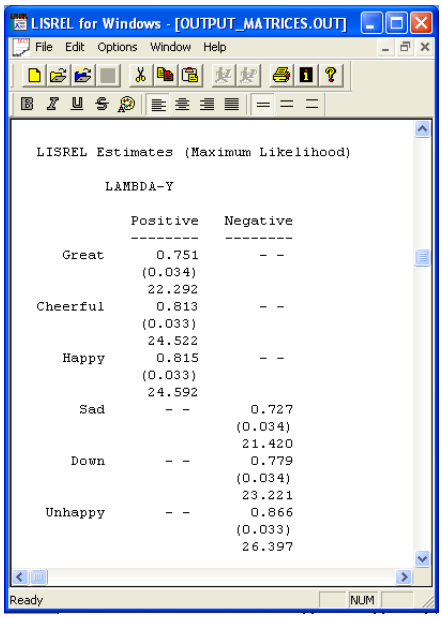
```
!status 33 to 36
VA 1 LY(1,2) LY(2,2) LY(3,2) LY(4,2) LY(5,2) LY(

FR TE(1,1) TE(2,2) TE(3,3) TE(4,4) TE(5,5) TE(6,(

ST .7 ALL

LE
shp6to33 status36

OU SC AD=off SO MI WP¤
```

2. The MA Command

Output

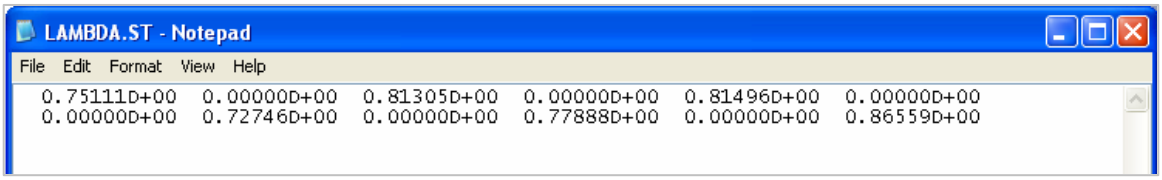
Additionally, entire start value matrices can be provided to LISREL. These matrices are usually obtained from less restricted models when attempting to fit a more restricted (nested) model. Parameter matrices can be outputted from a less restricted model by adding **<matrix> = <file>** to the OU line of that model.

```
LE
   Positive  Negative
OU AD=OFF RS MI ND=3 LY=LAMBDA.ST  PS=PSI.ST  TE=THETA.ST
¤
```



The above outputs three files (LAMBDA.ST, PSI.ST, and THETA.ST), each containing a matrix of their respective parameter estimates. The lambda estimates are to the right. ⟶

The outputted Lambda matrix is in a format standard to LISREL. All numbers are presented in six columns, each being eleven characters wide and presented in scientific notation:



Input

Once a matrix has been saved to a file, the MA command can recall it to provide starting values in subsequent models. The MA command format is:

MA <matrix> FI = <file>, for example:

```
FR TE(1,1) TE(2,2) TE(3,3)

FR LY(4,2) LY(5,2) LY(6,2)
FR TE(4,4) TE(5,5) TE(6,6)

MA LY FI=LAMBDA.ST
MA PS FI=PSI.ST
MA TE FI=THETA.ST

LE
   Positive  Negative
```

Important note: An outputted matrix will contain the estimates of all free parameters in a model. If a more restricted model then uses those estimates as start values, parameters that were initially free but are now fixed will be assigned a fixed value equal to the previous model's estimate. For instance, if PS(3,1) was estimated to be .24 in the original model but is fixed in the more restricted model, then using the MA command will instruct LISREL to fix PS(2,1) to .24 instead of the assumed fixed value of 0 (i.e., no covariance). This must be remedied by adding an additional VA statement after the MA line:

```
MA LY FI=LAMBDA.ST
MA PS FI=PSI.ST
VA 0.0 PS(2,1)
MA TE FI=THETA.ST
```

Here, we are telling LISREL that the initial Psi matrix to use is located in the file PSI.ST and then telling it to overwrite the estimate of PS(3,1) with the value of 0.

Start Value Tips & Tricks

Overriding Values

Always remember that ST, VA, and MA commands will overwrite each other. It is especially important to remember this when fixed parameters take on values that you did not intend.

The NS Option

Adding the option NS to the OU line is handy when you are coaxing a stubborn model to converge. The NS option tells LISREL not to use any form of initial estimation on any parameters. If a model does not converge after adding start values, try those same start values with the NS option. When using this option it is important to provide starting estimates for all freely estimated parameters. Without a starting point, the ML algorithm cannot begin its iterations.

Unreasonable Start Values

When error variances keep going negative, it may help to implement unreasonable start values. Starting the diagonal of your TE matrix at an obscenely high value (such as 2.0) may give LISREL enough room to bring the TEs down while the rest of the model converges without dropping them below zero.

Using GLS instead of ML

If a model runs through a series of iterations, but then gives an error stating that a matrix is not positive definite, it may be the result of a Heywood case (a.k.a., negative error variance). Because ML estimation is somewhat prone to creating Heywood cases, other forms of estimation such as generalized least squares (GLS) may get your model to converge where ML has failed. When this is the case, it is possible to run the model using GLS estimation, store the estimates, and then use those estimates as the starting values for the same model under ML estimation.

Editing Matrices

Using a similar model's solution as start values should get LISREL very close to a proper solution before its iterations even begin. Possibly TOO close. If LISREL does not have enough "jiggle room" around a solution, the ML iterations may successively move farther and farther away from a proper solution. If LISREL cannot find its way back to the original solution, then the model will never converge. If you think this is happening to you model, the input start values can be increase or decreased slightly so that LISREL will move away from them and "find" the correct solution. We have a SAS file designed to edit start value matrices if this becomes something you need to do (see Kuant Tools on our website, quant.ku.edu).

Checking Modification Indices

Although high modification indices usually indicate model misfit, a high and unexpected modification index may be a sign that your model has converged on a local minima (a solution that works, but is sub-optimal), especially when overall model fit is poor. One way to check for this is by freeing the parameter with the high index, running your model, outputting the solution matrices, then using those matrices as start values in a model where the high index parameter is again fixed. Remember to set this parameter's value back to zero by adding a VA statement after your MA command.

Start Value Tips & Tricks (cont'd)

Using Global Start Values

Many models will converge with just a single start value set for all estimates. While there is no start value that will work for every model, .7 is a good place to start. If .7 does not work, try adjusting to .8 then .6, and so on.