WinLTA USER'S GUIDE for Data Augmentation

Version 1.0

(for WinLTA Version 3.0)

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INTRODUCTION

WinLTA can be used to run latent class analysis (LCA) and latent transition analysis (LTA). This software uses an EM algorithm to obtain maximum likelihood estimates for all parameters. Because standard errors are not a byproduct of the EM algorithm, this method does not allow the user to conduct hypothesis tests. Recently, data augmentation (DA), a Gibbs sampling-based procedure, has been added to WinLTA. Once a final latent class or latent transition model has been selected and the EM algorithm has been applied, DA can be used to obtain final parameter estimates and standard errors. DA uses the data, the LCA or LTA model, and the EM maximum likelihood estimates obtained from a previous WinLTA run to multiply impute the latent variables. The within-imputation and between-imputation variability are then combined to yield an overall estimate of the standard error for each parameter. This procedure provides information about the variability of point estimates and enables the user to conduct hypothesis tests.

DATA AUGMENTATION AND MULTIPLE IMPUTATION (MI)

Multiple imputation, which provides the basis for DA, is a general approach to missing data problems that has been shown to produce high quality estimates and reliable standard errors (Schafer, 1997). The theoretical details of DA are described in detail in Schafer (1997), and its application to WinLTA is presented in Hyatt, Collins, and Schafer (1999), and so DA will be described only briefly here. This approach to missing data has been incorporated into WinLTA 3.0. DA treats the latent classes and latent statuses as missing, and uses multiple imputation to replace them, in a manner very similar to how ordinary missing data are handled by programs such as NORM (Schafer, 1997). Multiple imputation employs DA, an iterative simulation procedure conceptually similar to the EM algorithm. This iterative procedure produces a sequence of plausible sets of LTA parameter estimates. Because DA is a stochastic process, each data set contains randomly different values for the latent class and/or latent status membership variables. However, the observed response pattern frequencies are identical to the original input data. Because the imputed data sets are complete, i.e. individuals have been placed in latent classes and/or latent statuses, finding estimates of the parameters and their associated standard errors in each data set can be done using standard complete data methods. For example, estimates of the γ parameters are obtained simply by computing the proportion of individuals in the sample imputed to be in each latent class. The standard error within each data set corresponding to each parameter can be computed using the usual expression for the standard error of a proportion: $(pq/n)^{1/2}$.

Consecutively generated sets may be serially dependent. A procedure where a set is drawn, then some number of consecutively generated sets are discarded, then another set is drawn, tends to produce independent draws of parameters. The number of imputed data sets to be produced is specified by the user; typically ten data sets are sufficient for producing reliable estimates in latent class and latent transition models. Parameter estimates and their standard errors are retained from each imputation's analysis, and are combined by averaging the estimates across imputations (Rubin, 1987). Both within data set and between data set variability must be taken into account when arriving at the estimate of uncertainty associated with each parameter. The resultant parameter estimates and their standard errors can then be used to describe the variability about the parameter estimates and to conduct hypothesis tests. The difference between EM and DA estimates is that EM estimates are the mode of the likelihood function, and DA estimates are the mean of the Bayesian posterior distribution. In practice, EM and DA parameter estimates will be very similar. (See Schafer, 1997 and Brunner & Schafer, 1997 for more details on multiple imputation and its application in LTA.)

DA is important because it provides standard errors of parameter estimates, which allow us to conduct hypothesis tests. For example, we can assess group differences in the probabilities of latent class membership. One obvious issue that arises in this approach to hypothesis testing is the overall Type I error rate. The problem here is the same one that arises when hypothesis tests on individual parameters are performed in structural equation modeling: with this many non-independent hypothesis tests, the possibility of capitalizing on chance can be large. This can be dealt with in a number of ways. One approach is to draw a clear distinction between a priori hypotheses and a more ad hoc exploration of findings. In situations where literature or theory do not lead to such clear-cut predictions, a Bonferroni type adjustment can be applied. DA can also be used to implement ANOVA-like contrasts for latent transition models. A thorough example of hypothesis testing and the use of contrasts is presented in Collins, Schafer, Lanza, and Flaherty (in preparation).

DA requires several pieces of information, which the user inputs on the DA Tab. First, the user must provide the number of datasets to be imputed, *m*. We have found that for most latent class and latent transition models ten imputations are sufficient to yield reliable estimates of the standard errors of parameters. Second, as discussed above, successive iterations of the DA procedure are not statistically independent. In other words, data from successive iterations may be correlated. By selecting only every k^{th} iteration and discarding the others it is possible to eliminate serial dependency in the resulting data sets. Thus the user must input a value for *k*, the number of iterations between each imputation. A good rule of thumb is that a minimum value for *k* is the number of iterations that was needed for the EM algorithm to converge in the initial estimation of the LTA model. Following this rule will typically yield imputations that are statistically independent from one another. Third, the user must specify a random number generator seed. Results can be replicated exactly only if the seed is the same.

All Bayesian procedures require specification of a prior distribution. By default, WinLTA 3.0 uses a type of noninformative prior known as a Jeffreys prior. This prior generally will not influence the results very much unless the data supply relatively little information, for example when the sample size is small.

Diagnostics

After data augmentation has been run, it is important to verify that the chosen *k* is sufficiently large to ensure statistically independent imputations. Two diagnostic procedures, plots of the autocorrelation function and time series plots, can be used to assess independence of successive draws. It would be overwhelming to examine these plots for every parameter estimated in LCA and LTA. Fortunately, it is possible to perform diagnostics on the *worst linear function* corresponding to each set of parameters (γ, δ, τ, little ρ, big ρ) so that only five vectors need to be examined. Of all possible linear combinations of parameters, the worst linear function is the one that is the slowest to approach convergence in the DA procedure (Schafer, 1997). If there are problems with serial dependency in a set of parameters, they will typically be revealed by examining this function.

There are two tools for examining the worst linear function: the time series plot and the autocorrelation function. For time series plots, the worst linear function of each set of parameters is plotted against the iteration number. These plots should appear to be horizontal bands fluctuating randomly around some value. The user should watch for drift (a slow, discernable trend) and mode switching (a sudden jump up or down). If either of these symptoms occurs, the user should determine whether an iteration number can be determined beyond which these symptoms are no longer in evidence. If there is such a point in the series, the user should choose a value of *k* at least equal to this iteration number. If drift and/or mode switching occur throughout the series, there may be an identification problem. The user should try imposing some additional parameter restrictions and rerunning both the EM and DA procedures.

The second tool to be used for assessing statistical independence of draws is the autocorrelation function, which indicates whether there is serial dependence in the array. The autocorrelation plot has the lag on the abscissa and the autocorrelation on the ordinate. Any autocorrelations within a 95% confidence interval around zero are not significant. Every autocorrelation plot displays a correlation of 1.0 for lag 0. When the autocorrelation drops to near zero, the series has converged. If the plot of any set of parameters does not drop to near 0 by lag *k*, this suggests that the random draws are not independent. In this case a larger value of k should be specified and DA should be rerun. It is better to err on the side of overestimating *k*, as there is nothing to be gained except computing time for using a smaller *k* (see Schafer, 1997 for more information on assessing statistical independence of draws).

EXAMPLE 3: DA RESULTS

The objective of this section is to illustrate DA. We will present an example using DA to obtain standard errors of all parameter estimates.

Following up on the analysis for Example 3 in the WinLTA manual, this section presents the use of DA for a latent transition problem with three measurement occasions, three latent classes, and two latent statuses. Although these are artificial data, let us assume that the participants are 2000 underprivileged school children. Their teachers have been asked to answer three questions about each child's performance in math, reading and science three times during the school year: the beginning, middle and end of the school year. These three questions will be used to determine whether the child's performance is above grade level or at or below grade level. Performance may change over time, thus this is a two category dynamic latent variable. In addition, at the beginning of the year, the teachers were asked to answer three questions about each child. The answers will be used to identify three groups of children: those who have no learning disability, those who have a mild learning disability, and those who have a severe learning disability. Learning disability is a three category static latent variable. This model allows us to compare transitions in school performance across the three learning disability groups.

WinLTA was used to fit the above model (see the Example 3 appendix of the WinLTA manual for details on fitting the model). Once it has been established that the overall fit of the model is reasonable and that the latent statuses can be interpreted in a meaningful way, the next step would be to examine the EM parameter estimates. In practice, an investigator would not embark upon the DA procedure unless the model as estimated by EM fit reasonably well and was of sufficient interest to pursue further. Once the overall model has been deemed satisfactory, this is followed by applying DA to obtain final parameter estimates and their respective standard errors.

The G^2 for this model was 3595 with 6120 degrees of freedom; having a G^2 substantially less than the degrees of freedom is an indication of good model fit. The EM algorithm converged in 37 iterations, so an appropriate value of *k* (the number of iterations between imputations) would be an integer greater than or equal to 37. In this example we will choose *k* to be 100. This choice is somewhat arbitrary, but *k*=100 is sufficiently greater than 37 so that serial dependence is unlikely to be a problem. Choosing *k* to be 37 may have been sufficient in this example; the only cost in choosing a value of *k* larger than necessary to achieve statistical independence of draws is additional processor time.

The EM parameter estimates for Example 3 are reported in the appendix from the WinLTA manual. Based on the gamma parameters we expect 38.5% of the sample to be in the 'no learning disability' latent class, 41.6% in the 'mild learning disability' latent class, and 19.9% in the 'severe learning disability' latent class. At Time 1, 44.6% of individuals in the 'no learning disability' class are expected to be above grade level, as opposed to 30.1% for the mild disability group and 35.9% for the severe disability group. Although these findings may be of interest, without standard errors we cannot determine whether these group differences are significant. The following section will explain how to run data augmentation for Example 3 in order to obtain standard errors for the parameter estimates.

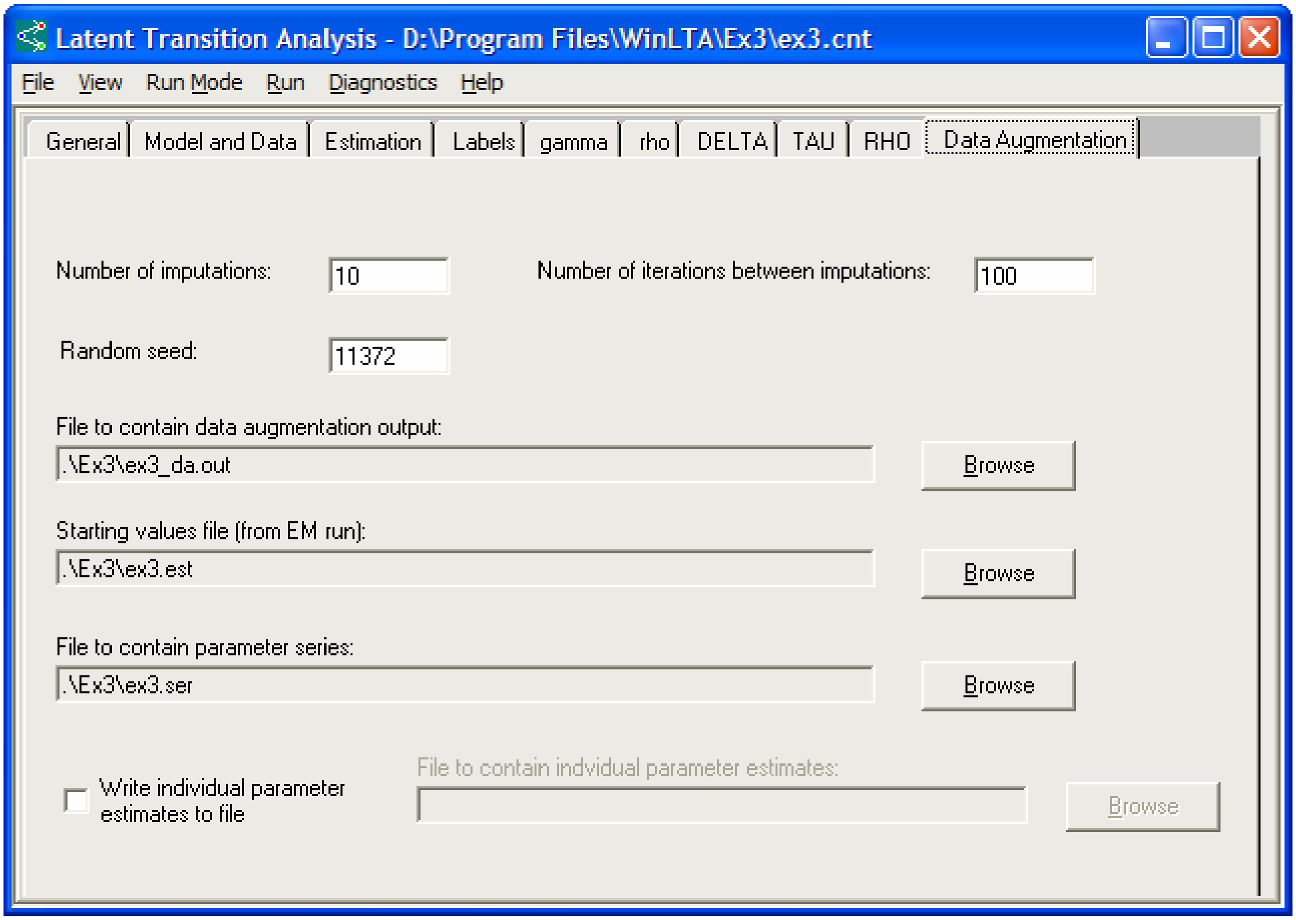
Setting Up the Control File to Run DA

In order to run data augmentation for Example 3, the user should open the WinLTA control file used for the EM estimation in WinLTA 3.0. To do this, click on File, Open Control File, and choose the folder for Example 3. WinLTA 3.0 is backward-compatible, that is control files created in WinLTA 2.0 or later can be opened in WinLTA 3.0. However, note that once a control file is converted for Version 3.0 and saved it cannot be opened with an earlier version of LTA. It is important to note that data augmentation will implement parameter restrictions which appear in the control file. DA should be run using the same control file that was used to first run the EM estimation so that identical parameter restrictions are applied in both the EM and DA runs.

A new feature in this version of LTA is the run mode. If you click on Run Mode, you will see that we are in the ‘EM Model’ mode, which can be used to run EM estimation as in earlier versions. Note that all items on the Data Augmentation tab are greyed out when in EM mode. In order to run DA we must switch to DA mode. To do this, click on Run Mode and switch to ‘DA Model.’ Now note the tabs that contain greyed out information: Model and Data, Labels, gamma, rho, DELTA, TAU, and RHO. Information that is greyed out is disabled so that critical information cannot be changed. All information on these tabs must be the same for the EM and DA estimation. Information on the General and Estimation tabs are not disabled; these pieces of information are irrelevant to DA and thus changes in those fields would not affect the estimation. Comments on the General tab will appear at the top of the DA output file; the user is free to make additional comments here related to the DA run.

If you go to the Data Augmentation tab you will see all fields relevant to the DA estimation. Defaults are supplied in all fields on this tab. The following section explains each of the fields on the Data Augmentation tab.

Data Augmentation tab window



- **Number of Imputations:** The number of imputed datasets to be created; we recommend ten or more. The default value is ten.
- **Number of Iterations Between Imputations:** A good rule of thumb is to select a number equal or greater than the number of iterations that was needed for the EM algorithm to converge. A default value of 100 appears in this field, but it is important to increase this if the EM estimation took longer than 100 iterations to converge.
- **Random Seed:** Specify a random number generator seed; DA results can be replicated exactly only if the seed is the same. By default a random seed will be provided in this field. This means that if two DA runs with identical input use default random seeds, the results will not be identical. Thus, if the user wishes to replicate a previous DA run, it would be necessary to specify the random number generator seed used by that run.
- **File to Contain Data Augmentation Output:** Specify path and filename for the output file by hitting the Browse button. Although not essential, it is recommend that the user give this

file a name different from the name of the file containing the EM output.

- **Starting Values File (From EM Run):** Specify path and filename for the file containing the final parameter estimates from the EM run by hitting the Browse button. This is typically the same path and filename given for the parameter estimates on the General tab.
- **File to Contain Parameter Series:** Specify path and filename for the file to contain the parameter series by hitting the Browse button. This file will be used for diagnostics.
- **Write Individual Parameter Estimates to File:** By selecting this option a parameter series for each individual parameter is created, rather than a parameter series for each of the five worst linear functions of sets of parameters. This option will produce a large file, and thus this option should only be selected for users who would like to examine the series for individual parameters.
    - **File to Contain Individual Parameter Estimates:** If the option to write individual parameter estimates to file is selected, specify path and filename for the file to contain the individual parameter series by hitting the Browse button.

Saving Your Work and Running WinLTA

The procedures to save the control file, run WinLTA, and view the outfile are similar to those in previous versions of WinLTA.

- **Saving the control file:** In WinLTA, click on File, and then Save. If this is the first time you have saved this file, a Save As dialog box will appear. In this box you can choose the location of the file and you will be required to enter a filename. By default, the file will be saved with the file extension .cnt. If you added data augmentation information to a control file that was previously used to run EM, it is fine to save using the same filename. Information contained in the control file for running data augmentation is additional to any previously stored information. However, once a control file has been converted to Version 3.0 they cannot be opened in earlier versions of WinLTA.

- **To run WinLTA:** EM estimation must be completed before data augmentation can be run. EM can be run by clicking on Run when in EM mode. Once the information on data augmentation is completely entered into the control file and the file has been saved, click on Run while in DA mode to run data augmentation. If you have not saved the current version of the control file, you will see a dialog box that asks you if you would like to save before proceeding. Choosing Yes will save the file and run DA automatically. Choosing No will run DA without saving the file. Choosing Cancel will allow you to return to the control file without running DA.

  Once DA begins running, a separate dialog box entitled “LTA Run” will appear on your screen and WinLTA will automatically be minimized. This dialog box tells you the date and time the run began and finished, as well as the current iteration number it has reached. The program will run for a total number of iterations equal to the number of imputations times the number of iterations between imputations. The box also has two buttons: Abort and Get Info. Pressing the Abort button during the run will cancel the run. Clicking on Get Info gives you the iteration number at that moment so you do not have to wait for the information to be updated. The information in this dialog box is automatically updated every 5 seconds. Once the run is finished, the Abort button changes to Close. When you press the Close button, WinLTA will automatically be restored as the active window. You can still access WinLTA on your taskbar without pressing the Close button, but Close must be pressed before another run can be started.

- **Viewing the WinLTA DA outfile:** Once the DA run is completed, you can view the output file by clicking on View, and Current LTA Outfile. If you would like to view a different saved outfile, click on Choose LTA Outfile.

- **Files created by WinLTA:** In addition to the parameter series file and the DA output file, data augmentation produces imputed datasets and saves them in the directory which contains the control file. One file will be created for each imputed dataset using the naming convention Imp1.dat, Imp2.dat, and so on.

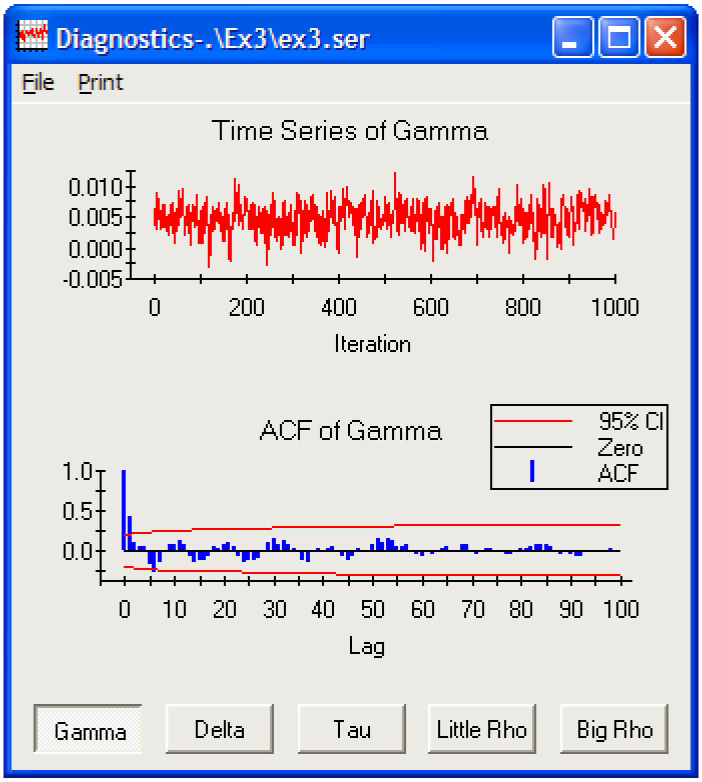
Examination of Convergence

In order to verify that the chosen *k* is sufficiently large to ensure statistically independent imputations, the time series plots and autocorrelation function must be viewed. Up to five sets of plots will be created, where each set corresponds to the worst linear function of a set of parameters: the γ parameters, δ parameters, τ parameters, ρ parameters associated with the static latent variable (little ρ), and ρ parameters associated with the dynamic latent variable (big ρ). For latent class models, only plots for the γ parameters and ρ parameters associated with the static latent variable are produced. Latent transition models without a grouping variable yield plots for the δ parameters, τ parameters and ρ parameters associated with the dynamic latent variable. For latent transition models with a grouping variable, all five plots are produced. Any problems with serial dependency should be revealed by examining these functions.

To plot the parameter series, click on Diagnostics, then Plot Series. This automatically brings up plots for the gamma parameters. Each of the individual plots can be printed by clicking on Print, then on Print Time-Series or Print ACF. The parameter series from previous runs can be opened by clicking on File, Open. To close the window click on File, Close.

The following is an example of the time series plot and autocorrelation function for the gamma parameters from a DA run using WinLTA.

WinLTA Screenshot for Assessing Convergence: Gamma Parameters



- **Time Series of Gamma:** Time series plot for the worst linear function of the gamma parameters. Plot should show random fluctuation around some value. We see no evidence of drift or mode switching.
- **ACF of Gamma:** Autocorrelation function for the worst linear function of the gamma parameters. Includes a 95% confidence interval about zero. Value of correlation should drop to nearly zero by the lag equal to the number of imputations between iterations (the last lag plotted). It is clear that our choice of k=100 is sufficiently large for the gamma parameters in Example 3.
- **Gamma, Delta, Tau, Little Rho, Big Rho:** Click on buttons to examine the set of plots associated with the worst linear function for each set of parameters.

The WinLTA DA Output File

The following is an example of an output file from a DA run using WinLTA. The reference numbers that have been added to the output correspond to the endnotes that follow.

```
PROGRAM STARTED:       Fri Mar 29 17:15:35 2002

[1]* DATA SET IS TEST3R
* STATIC LATENT VARIABLE WITH THREE CLASSES
* DYNAMIC LATENT VARIABLE WITH TWO STATUSES
* THREE TIMES
* THIS IS "RANDOM" DATA

 **************************************************
[2]INFORMATION ABOUT THIS JOB:

 RUN TYPE: DATA AUGMENTATION

 CONTROL DATA READ FROM FILE:
D:\WinLTA\Ex3\ex3.cnt

 START VALUES READ FROM FILE:
.\Ex3\ex3.est

 DATA ANALYZED IN THIS RUN READ FROM FILE:
.\Ex3\ex3.dat

 OUTPUT SAVED IN FILE:
.\Ex3\ex3_da.out

 PARAMETER SERIES DATA SAVED IN FILE:
.\Ex3\ex3.ser

 STATIC LATENT VARIABLE                     YES
 NUMBER OF LATENT CLASSES                     3
 NUMBER OF MANIFEST ITEMS                     3

 DYNAMIC LATENT VARIABLE                    YES
 NUMBER OF LATENT STATUSES                    2
 NUMBER OF OCCASIONS OF MEASUREMENT           3
 NUMBER OF MANIFEST ITEMS PER OCCASION        3
 TYPE OF PROCESS                    FIRST-ORDER

 NUMBER OF SUBJECTS                        2000
 NUMBER OF UNIQUE RESPONSE PATTERNS        1219
 NUMBER OF ITERATIONS
  BETWEEN IMPUTATIONS                       100
 NUMBER OF IMPUTATIONS                       10
 RANDOM GENERATOR SEED                    11372
 MISSING DATA IN RESPONSE PATTERNS           NO

 **************************************************

[3]THE FOLLOWING PARAMETER RESTRICTIONS HAVE BEEN SPECIFIED
 WHERE 0=FIXED TO START VALUE
       1=FREE
       2 OR GREATER MEANS CONSTRAINED EQUAL TO ANY OTHER
         PARAMETER WITH THE SAME DESIGNATION
```

```
**************************************************

 LITTLE RHO PARAMETERS
 LITTLE RHOS ARE PROBABILITIES OF RESPONSES
 TO ITEMS MEASURING THE STATIC LATENT VARIABLE
 CONDITIONAL ON LATENT CLASS MEMBERSHIP

          RESPONSE CATEGORY  1

         | P N | P N | P N |
         | R O | R O | R O |
         | O   | O   | O   |
         | B   | B   | B   |
         | L   | L   | L   |
         | M   | M   | M   |
         | 1   | 2   | 3   |
         |     |     |     |
 NO LD      3     5     8
 MILD LD    3     4     7
 SEV LD     2     5     7

          RESPONSE CATEGORY  2

         | P Y | P Y | P Y |
         | R E | R E | R E |
         | O S | O S | O S |
         | B   | B   | B   |
         | L   | L   | L   |
         | M   | M   | M   |
         | 1   | 2   | 3   |
         |     |     |     |
 NO LD      2     4     7
 MILD LD    2     5     8
 SEV LD     2     4     8

          RESPONSE CATEGORY  3

         | P U | P   | P   |
         | R N | R   | R   |
         | O D | O   | O   |
         | B E | B   | B   |
         | L T | L   | L   |
         | M E | M   | M   |
         | 1 R | 2   | 3   |
         |   M |     |     |
 NO LD      2     0     0
 MILD LD    2     0     0
 SEV LD     3     0     0


 **************************************************

 BIG RHO PARAMETER RESTRICTIONS
 BIG RHOS ARE PROBABILITIES OF RESPONSE
 TO ITEMS MEASURING THE DYNAMIC LATENT VARIABLE
```

```
 CONDITIONAL ON LATENT STATUS, LATENT CLASS, AND TIME

          BIG RHO PARAMETER RESTRICTIONS FOR LATENT CLASS "NO LD   " AT
TIME  1

          RESPONSE CATEGORY  1

         | M B | R B | S B |
         | A E | E E | C E |
         | T L | A L | I L |
         | H O | D O | E O |
         |   W | I W | N W |
         |     | N   | C   |
         |     | G   | E   |
         |     |     |     |
 BELOW GL   2     3     4
 ABOVE GL   5     6     7

          RESPONSE CATEGORY  2

         | M A | R A | S A |
         | A B | E B | C B |
         | T O | A O | I O |
         | H V | D V | E V |
         |   E | I E | N E |
         |     | N   | C   |
         |     | G   | E   |
         |     |     |     |
 BELOW GL   5     6     7
 ABOVE GL   2     3     4

          BIG RHO PARAMETER RESTRICTIONS FOR LATENT CLASS "NO LD   " AT
TIME  2

          RESPONSE CATEGORY  1

         | M B | R B | S B |
         | A E | E E | C E |
         | T L | A L | I L |
         | H O | D O | E O |
         |   W | I W | N W |
         |     | N   | C   |
         |     | G   | E   |
         |     |     |     |
 BELOW GL   2     3     4
 ABOVE GL   5     6     7

          RESPONSE CATEGORY  2

         | M A | R A | S A |
         | A B | E B | C B |
         | T O | A O | I O |
         | H V | D V | E V |
         |   E | I E | N E |
         |     | N   | C   |
         |     | G   | E   |
         |     |     |     |
 BELOW GL   5     6     7
 ABOVE GL   2     3     4

          BIG RHO PARAMETER RESTRICTIONS FOR LATENT CLASS "NO LD   " AT
TIME  3

          RESPONSE CATEGORY  1

         | M B | R B | S B |
         | A E | E E | C E |
         | T L | A L | I L |
         | H O | D O | E O |
         |   W | I W | N W |
         |     | N   | C   |
         |     | G   | E   |
         |     |     |     |
 BELOW GL   2     3     4
 ABOVE GL   5     6     7

          RESPONSE CATEGORY  2

         | M A | R A | S A |
         | A B | E B | C B |
         | T O | A O | I O |
         | H V | D V | E V |
         |   E | I E | N E |
         |     | N   | C   |
         |     | G   | E   |
         |     |     |     |
 BELOW GL   5     6     7
 ABOVE GL   2     3     4

          BIG RHO PARAMETER RESTRICTIONS FOR LATENT CLASS "MILD LD " AT
TIME  1

          RESPONSE CATEGORY  1

         | M B | R B | S B |
         | A E | E E | C E |
         | T L | A L | I L |
         | H O | D O | E O |
         |   W | I W | N W |
         |     | N   | C   |
         |     | G   | E   |
         |     |     |     |
 BELOW GL   2     3     4
 ABOVE GL   5     6     7

          RESPONSE CATEGORY  2

         | M A | R A | S A |
         | A B | E B | C B |
         | T O | A O | I O |
```

```
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
 BELOW GL   5     6     7
 ABOVE GL   2     3     4

         BIG RHO PARAMETER RESTRICTIONS FOR LATENT CLASS "MILD LD " AT
TIME  2

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
 BELOW GL   2     3     4
 ABOVE GL   5     6     7

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
 BELOW GL   5     6     7
 ABOVE GL   2     3     4

         BIG RHO PARAMETER RESTRICTIONS FOR LATENT CLASS "MILD LD " AT
TIME  3

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
 BELOW GL   2     3     4
 ABOVE GL   5     6     7

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
 BELOW GL   5     6     7
 ABOVE GL   2     3     4

         BIG RHO PARAMETER RESTRICTIONS FOR LATENT CLASS "SEV LD  " AT
TIME  1

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
 BELOW GL   2     3     4
 ABOVE GL   5     6     7

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
 BELOW GL   5     6     7
 ABOVE GL   2     3     4

         BIG RHO PARAMETER RESTRICTIONS FOR LATENT CLASS "SEV LD  " AT
TIME  2

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
 BELOW GL   2     3     4
 ABOVE GL   5     6     7
```

```
          RESPONSE CATEGORY  2

         | M A | R A | S A |
         | A B | E B | C B |
         | T O | A O | I O |
         | H V | D V | E V |
         |   E | I E | N E |
         |     | N   | C   |
         |     | G   | E   |
         |     |     |     |
 BELOW GL   5     6     7
 ABOVE GL   2     3     4

          BIG RHO PARAMETER RESTRICTIONS FOR LATENT CLASS "SEV LD  " AT
TIME  3

          RESPONSE CATEGORY  1

         | M B | R B | S B |
         | A E | E E | C E |
         | T L | A L | I L |
         | H O | D O | E O |
         |   W | I W | N W |
         |     | N   | C   |
         |     | G   | E   |
         |     |     |     |
 BELOW GL   2     3     4
 ABOVE GL   5     6     7

          RESPONSE CATEGORY  2

         | M A | R A | S A |
         | A B | E B | C B |
         | T O | A O | I O |
         | H V | D V | E V |
         |   E | I E | N E |
         |     | N   | C   |
         |     | G   | E   |
         |     |     |     |
 BELOW GL   5     6     7
 ABOVE GL   2     3     4

 **************************************************

 GAMMA PARAMETER RESTRICTIONS
 GAMMAS ARE UNCONDITIONAL PROBABILITIES OF MEMBERSHIP
 IN EACH LATENT CLASS OF THE STATIC LATENT VARIABLE

 NO LD       1
 MILD LD     1
 SEV LD      1

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 DELTA PARAMETER RESTRICTIONS
 DELTAS ARE PROBABILITIES OF LATENT STATUS MEMBERSHIP
  CONDITIONAL ON LATENT CLASS


 DELTA PARAMETER RESTRICTIONS FOR LATENT CLASS "NO LD   "

           TIME 1
 BELOW GL    1
 ABOVE GL    1


 DELTA PARAMETER RESTRICTIONS FOR LATENT CLASS "MILD LD "

           TIME 1
 BELOW GL    1
 ABOVE GL    1


 DELTA PARAMETER RESTRICTIONS FOR LATENT CLASS "SEV LD  "

           TIME 1
 BELOW GL    1
 ABOVE GL    1

 **************************************************

 TAU PARAMETER RESTRICTIONS
 TAUS ARE PROBABILITIES OF LATENT STATUS MEMBERSHIP AT TIME T+1
(COLUMNS)
 CONDITIONAL ON LATENT STATUS MEMBERSHIP AT TIME T (ROWS)
 AND ON LATENT CLASS MEMBERSHIP



 TRANSITION PROBABILITIES FOR LATENT CLASS "NO LD   "

 ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 1
 COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2

         |  B |  A |
         |  E |  B |
         |  L |  O |
         |  O |  V |
         |  W |  E |
         |    |    |
         |  G |  G |
         |  L |  L |
 BELOW GL   1    1
 ABOVE GL   1    1

 ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2
 COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 3

         |  B |  A |
```

```
         | E |  B |
         | L |  O |
         | O |  V |
         | W |  E |
         |   |    |
         | G |  G |
         | L |  L |
BELOW GL   1    1
ABOVE GL   1    1

TRANSITION PROBABILITIES FOR LATENT CLASS "MILD LD "

ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 1
COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2

         | B |  A |
         | E |  B |
         | L |  O |
         | O |  V |
         | W |  E |
         |   |    |
         | G |  G |
         | L |  L |
BELOW GL   1    1
ABOVE GL   1    1

ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2
COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 3

         | B |  A |
         | E |  B |
         | L |  O |
         | O |  V |
         | W |  E |
         |   |    |
         | G |  G |
         | L |  L |
BELOW GL   1    1
ABOVE GL   1    1

TRANSITION PROBABILITIES FOR LATENT CLASS "SEV LD  "

ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 1
COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2

         | B |  A |
         | E |  B |
         | L |  O |
         | O |  V |
         | W |  E |
         |   |    |
         | G |  G |
         | L |  L |
BELOW GL   1    1
ABOVE GL   1    1

ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2
COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 3

         | B |  A |
         | E |  B |
         | L |  O |
         | O |  V |
         | W |  E |
         |   |    |
         | G |  G |
         | L |  L |
BELOW GL   1    1
ABOVE GL   1    1

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4

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         START VALUES

NOTE: THESE START VALUES ARE PARAMETER ESTIMATES
FROM A PREVIOUS RUN

**************************************************

LITTLE RHO PARAMETERS
LITTLE RHOS ARE PROBABILITIES OF RESPONSES
TO ITEMS MEASURING THE STATIC LATENT VARIABLE
CONDITIONAL ON LATENT CLASS MEMBERSHIP

         RESPONSE CATEGORY  1

        | P N | P N | P N |
        | R O | R O | R O |
        | O   | O   | O   |
        | B   | B   | B   |
        | L   | L   | L   |
        | M   | M   | M   |
        | 1   | 2   | 3   |
        |     |     |     |
NO LD    0.811 0.798 0.792
MILD LD  0.811 0.202 0.208
SEV LD   0.095 0.798 0.208

         RESPONSE CATEGORY  2

        | P Y | P Y | P Y |
        | R E | R E | R E |
        | O S | O S | O S |
        | B   | B   | B   |
        | L   | L   | L   |
        | M   | M   | M   |
        | 1   | 2   | 3   |
        |     |     |     |
NO LD    0.095 0.202 0.208
MILD LD  0.095 0.798 0.792
```

```
SEV LD   0.095 0.202 0.792

         RESPONSE CATEGORY  3

        | P U | P   | P   |
        | R N | R   | R   |
        | O D | O   | O   |
        | B E | B   | B   |
        | L T | L   | L   |
        | M E | M   | M   |
        | 1 R | 2   | 3   |
        |   M |     |     |
NO LD    0.095 0.000 0.000
MILD LD  0.095 0.000 0.000
SEV LD   0.811 0.000 0.000


**************************************************

BIG RHO PARAMETERS
BIG RHOS ARE PROBABILITIES OF RESPONSES
TO ITEMS MEASURING THE DYNAMIC LATENT VARIABLE
CONDITIONAL ON LATENT STATUS, LATENT CLASS, AND TIME

         RHO PARAMETERS FOR LATENT CLASS "NO LD   " AT TIME  1

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.801 0.802 0.805
ABOVE GL 0.199 0.198 0.195

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.199 0.198 0.195
ABOVE GL 0.801 0.802 0.805

         RHO PARAMETERS FOR LATENT CLASS "NO LD   " AT TIME  2

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.801 0.802 0.805
ABOVE GL 0.199 0.198 0.195

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.199 0.198 0.195
ABOVE GL 0.801 0.802 0.805

         RHO PARAMETERS FOR LATENT CLASS "NO LD   " AT TIME  3

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.801 0.802 0.805
ABOVE GL 0.199 0.198 0.195

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.199 0.198 0.195
ABOVE GL 0.801 0.802 0.805

         RHO PARAMETERS FOR LATENT CLASS "MILD LD " AT TIME  1
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```
          RESPONSE CATEGORY  1

         | M B | R B | S B |
         | A E | E E | C E |
         | T L | A L | I L |
         | H O | D O | E O |
         |   W | I W | N W |
         |     | N   | C   |
         |     | G   | E   |
         |     |     |     |
BELOW GL 0.801 0.802 0.805
ABOVE GL 0.199 0.198 0.195

          RESPONSE CATEGORY  2

         | M A | R A | S A |
         | A B | E B | C B |
         | T O | A O | I O |
         | H V | D V | E V |
         |   E | I E | N E |
         |     | N   | C   |
         |     | G   | E   |
         |     |     |     |
BELOW GL 0.199 0.198 0.195
ABOVE GL 0.801 0.802 0.805

          RHO PARAMETERS FOR LATENT CLASS "MILD LD " AT TIME  2

          RESPONSE CATEGORY  1

         | M B | R B | S B |
         | A E | E E | C E |
         | T L | A L | I L |
         | H O | D O | E O |
         |   W | I W | N W |
         |     | N   | C   |
         |     | G   | E   |
         |     |     |     |
BELOW GL 0.801 0.802 0.805
ABOVE GL 0.199 0.198 0.195

          RESPONSE CATEGORY  2

         | M A | R A | S A |
         | A B | E B | C B |
         | T O | A O | I O |
         | H V | D V | E V |
         |   E | I E | N E |
         |     | N   | C   |
         |     | G   | E   |
         |     |     |     |
BELOW GL 0.199 0.198 0.195
ABOVE GL 0.801 0.802 0.805

          RHO PARAMETERS FOR LATENT CLASS "MILD LD " AT TIME  3
```

```
          RESPONSE CATEGORY  1

         | M B | R B | S B |
         | A E | E E | C E |
         | T L | A L | I L |
         | H O | D O | E O |
         |   W | I W | N W |
         |     | N   | C   |
         |     | G   | E   |
         |     |     |     |
BELOW GL 0.801 0.802 0.805
ABOVE GL 0.199 0.198 0.195

          RESPONSE CATEGORY  2

         | M A | R A | S A |
         | A B | E B | C B |
         | T O | A O | I O |
         | H V | D V | E V |
         |   E | I E | N E |
         |     | N   | C   |
         |     | G   | E   |
         |     |     |     |
BELOW GL 0.199 0.198 0.195
ABOVE GL 0.801 0.802 0.805

          RHO PARAMETERS FOR LATENT CLASS "SEV LD  " AT TIME  1

          RESPONSE CATEGORY  1

         | M B | R B | S B |
         | A E | E E | C E |
         | T L | A L | I L |
         | H O | D O | E O |
         |   W | I W | N W |
         |     | N   | C   |
         |     | G   | E   |
         |     |     |     |
BELOW GL 0.801 0.802 0.805
ABOVE GL 0.199 0.198 0.195

          RESPONSE CATEGORY  2

         | M A | R A | S A |
         | A B | E B | C B |
         | T O | A O | I O |
         | H V | D V | E V |
         |   E | I E | N E |
         |     | N   | C   |
         |     | G   | E   |
         |     |     |     |
BELOW GL 0.199 0.198 0.195
ABOVE GL 0.801 0.802 0.805
```

```
         RHO PARAMETERS FOR LATENT CLASS "SEV LD  " AT TIME  2

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.801 0.802 0.805
ABOVE GL 0.199 0.198 0.195

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.199 0.198 0.195
ABOVE GL 0.801 0.802 0.805

         RHO PARAMETERS FOR LATENT CLASS "SEV LD  " AT TIME  3

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.801 0.802 0.805
ABOVE GL 0.199 0.198 0.195

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.199 0.198 0.195
ABOVE GL 0.801 0.802 0.805
```

```
 **************************************************

 GAMMA PARAMETERS
 GAMMAS ARE UNCONDITIONAL PROBABILITIES OF MEMBERSHIP IN EACH LATENT
CLASS
 OF THE STATIC LATENT VARIABLE

 NO LD     0.385
 MILD LD   0.416
 SEV LD    0.199

 **************************************************

 DELTA PARAMETERS
 DELTAS ARE PROBABILITIES OF LATENT STATUS MEMBERSHIP
  CONDITIONAL ON LATENT CLASS


 DELTA PARAMETERS FOR LATENT CLASS "NO LD   "

           TIME 1
 BELOW GL  0.554
 ABOVE GL  0.446


 DELTA PARAMETERS FOR LATENT CLASS "MILD LD "

           TIME 1
 BELOW GL  0.699
 ABOVE GL  0.301


 DELTA PARAMETERS FOR LATENT CLASS "SEV LD  "

           TIME 1
 BELOW GL  0.641
 ABOVE GL  0.359

 **************************************************

 TAU PARAMETERS
 TAUS ARE PROBABILITIES OF LATENT STATUS MEMBERSHIP AT TIME T+1
(COLUMNS)
 CONDITIONAL ON LATENT STATUS MEMBERSHIP AT TIME T (ROWS)
  AND ON LATENT CLASS MEMBERSHIP

 TRANSITION PROBABILITIES FOR LATENT CLASS "NO LD   "

 ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 1
 COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2

        |  B  |  A  |
        |  E  |  B  |
        |  L  |  O  |
```

```
        |  O  |  V  |
        |  W  |  E  |
        |     |     |
        |  G  |  G  |
        |  L  |  L  |
BELOW GL 0.627 0.373
ABOVE GL 0.402 0.598

ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2
COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 3

        |  B  |  A  |
        |  E  |  B  |
        |  L  |  O  |
        |  O  |  V  |
        |  W  |  E  |
        |     |     |
        |  G  |  G  |
        |  L  |  L  |
BELOW GL 0.831 0.169
ABOVE GL 0.398 0.602

TRANSITION PROBABILITIES FOR LATENT CLASS "MILD LD "

ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 1
COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2

        |  B  |  A  |
        |  E  |  B  |
        |  L  |  O  |
        |  O  |  V  |
        |  W  |  E  |
        |     |     |
        |  G  |  G  |
        |  L  |  L  |
BELOW GL 0.719 0.281
ABOVE GL 0.296 0.704

ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2
COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 3

        |  B  |  A  |
        |  E  |  B  |
        |  L  |  O  |
        |  O  |  V  |
        |  W  |  E  |
        |     |     |
        |  G  |  G  |
        |  L  |  L  |
BELOW GL 0.703 0.297
ABOVE GL 0.423 0.577

TRANSITION PROBABILITIES FOR LATENT CLASS "SEV LD  "

ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 1
COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2

        |  B  |  A  |
        |  E  |  B  |
        |  L  |  O  |
        |  O  |  V  |
        |  W  |  E  |
        |     |     |
        |  G  |  G  |
        |  L  |  L  |
BELOW GL 0.653 0.347
ABOVE GL 0.409 0.591

ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2
COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 3

        |  B  |  A  |
        |  E  |  B  |
        |  L  |  O  |
        |  O  |  V  |
        |  W  |  E  |
        |     |     |
        |  G  |  G  |
        |  L  |  L  |
BELOW GL 0.764 0.236
ABOVE GL 0.340 0.660
```

```
5**************************************************************
 ***  Final Parameter Estimates Based on Data Augmentation  ***
 **************************************************************

 **************************************************

LITTLE RHO PARAMETERS
LITTLE RHOS ARE PROBABILITIES OF RESPONSES
TO ITEMS MEASURING THE STATIC LATENT VARIABLE
CONDITIONAL ON LATENT CLASS MEMBERSHIP

         RESPONSE CATEGORY  1

        | P N | P N | P N |
        | R O | R O | R O |
        | O   | O   | O   |
        | B   | B   | B   |
        | L   | L   | L   |
        | M   | M   | M   |
        | 1   | 2   | 3   |
        |     |     |     |
NO LD    0.808 0.793 0.798
MILD LD  0.808 0.207 0.202
SEV LD   0.096 0.793 0.202

         RESPONSE CATEGORY  2
```

```
        | P Y | P Y | P Y |
        | R E | R E | R E |
        | O S | O S | O S |
        | B   | B   | B   |
        | L   | L   | L   |
        | M   | M   | M   |
        | 1   | 2   | 3   |
        |     |     |     |
NO LD    0.096 0.207 0.202
MILD LD  0.096 0.793 0.798
SEV LD   0.096 0.207 0.798

         RESPONSE CATEGORY  3

        | P U | P   | P   |
        | R N | R   | R   |
        | O D | O   | O   |
        | B E | B   | B   |
        | L T | L   | L   |
        | M E | M   | M   |
        | 1 R | 2   | 3   |
        |   M |     |     |
NO LD    0.096   -     -
MILD LD  0.096   -     -
SEV LD   0.808   -     -


**************************************************

BIG RHO PARAMETERS
BIG RHOS ARE PROBABILITIES OF RESPONSES
TO ITEMS MEASURING THE DYNAMIC LATENT VARIABLE
CONDITIONAL ON LATENT STATUS, LATENT CLASS, AND TIME

         RHO PARAMETERS FOR LATENT CLASS "NO LD   " AT TIME  1

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.800 0.799 0.804
ABOVE GL 0.200 0.201 0.196

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
```

```
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.200 0.201 0.196
ABOVE GL 0.800 0.799 0.804

         RHO PARAMETERS FOR LATENT CLASS "NO LD   " AT TIME  2

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.800 0.799 0.804
ABOVE GL 0.200 0.201 0.196

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.200 0.201 0.196
ABOVE GL 0.800 0.799 0.804

         RHO PARAMETERS FOR LATENT CLASS "NO LD   " AT TIME  3

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.800 0.799 0.804
ABOVE GL 0.200 0.201 0.196

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
```

```
         | H V | D V | E V |
         |   E | I E | N E |
         |     | N   | C   |
         |     | G   | E   |
         |     |     |     |
BELOW GL 0.200 0.201 0.196
ABOVE GL 0.800 0.799 0.804

         RHO PARAMETERS FOR LATENT CLASS "MILD LD " AT TIME  1

         RESPONSE CATEGORY  1

         | M B | R B | S B |
         | A E | E E | C E |
         | T L | A L | I L |
         | H O | D O | E O |
         |   W | I W | N W |
         |     | N   | C   |
         |     | G   | E   |
         |     |     |     |
BELOW GL 0.800 0.799 0.804
ABOVE GL 0.200 0.201 0.196

         RESPONSE CATEGORY  2

         | M A | R A | S A |
         | A B | E B | C B |
         | T O | A O | I O |
         | H V | D V | E V |
         |   E | I E | N E |
         |     | N   | C   |
         |     | G   | E   |
         |     |     |     |
BELOW GL 0.200 0.201 0.196
ABOVE GL 0.800 0.799 0.804

         RHO PARAMETERS FOR LATENT CLASS "MILD LD " AT TIME  2

         RESPONSE CATEGORY  1

         | M B | R B | S B |
         | A E | E E | C E |
         | T L | A L | I L |
         | H O | D O | E O |
         |   W | I W | N W |
         |     | N   | C   |
         |     | G   | E   |
         |     |     |     |
BELOW GL 0.800 0.799 0.804
ABOVE GL 0.200 0.201 0.196

         RESPONSE CATEGORY  2

         | M A | R A | S A |
         | A B | E B | C B |
```

```
         | T O | A O | I O |
         | H V | D V | E V |
         |   E | I E | N E |
         |     | N   | C   |
         |     | G   | E   |
         |     |     |     |
BELOW GL 0.200 0.201 0.196
ABOVE GL 0.800 0.799 0.804

         RHO PARAMETERS FOR LATENT CLASS "MILD LD " AT TIME  3

         RESPONSE CATEGORY  1

         | M B | R B | S B |
         | A E | E E | C E |
         | T L | A L | I L |
         | H O | D O | E O |
         |   W | I W | N W |
         |     | N   | C   |
         |     | G   | E   |
         |     |     |     |
BELOW GL 0.800 0.799 0.804
ABOVE GL 0.200 0.201 0.196

         RESPONSE CATEGORY  2

         | M A | R A | S A |
         | A B | E B | C B |
         | T O | A O | I O |
         | H V | D V | E V |
         |   E | I E | N E |
         |     | N   | C   |
         |     | G   | E   |
         |     |     |     |
BELOW GL 0.200 0.201 0.196
ABOVE GL 0.800 0.799 0.804

         RHO PARAMETERS FOR LATENT CLASS "SEV LD  " AT TIME  1

         RESPONSE CATEGORY  1

         | M B | R B | S B |
         | A E | E E | C E |
         | T L | A L | I L |
         | H O | D O | E O |
         |   W | I W | N W |
         |     | N   | C   |
         |     | G   | E   |
         |     |     |     |
BELOW GL 0.800 0.799 0.804
ABOVE GL 0.200 0.201 0.196

         RESPONSE CATEGORY  2

         | M A | R A | S A |
```

```
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.200 0.201 0.196
ABOVE GL 0.800 0.799 0.804

         RHO PARAMETERS FOR LATENT CLASS "SEV LD  " AT TIME  2

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.800 0.799 0.804
ABOVE GL 0.200 0.201 0.196

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.200 0.201 0.196
ABOVE GL 0.800 0.799 0.804

         RHO PARAMETERS FOR LATENT CLASS "SEV LD  " AT TIME  3

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.800 0.799 0.804
ABOVE GL 0.200 0.201 0.196

         RESPONSE CATEGORY  2
```

```
        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
 BELOW GL 0.200 0.201 0.196
 ABOVE GL 0.800 0.799 0.804

 **************************************************

 GAMMA PARAMETERS
 GAMMAS ARE UNCONDITIONAL PROBABILITIES OF MEMBERSHIP IN EACH LATENT
CLASS
 OF THE STATIC LATENT VARIABLE

 NO LD     0.391
 MILD LD   0.409
 SEV LD    0.200

 **************************************************

 DELTA PARAMETERS
 DELTAS ARE PROBABILITIES OF LATENT STATUS MEMBERSHIP
  CONDITIONAL ON LATENT CLASS


 DELTA PARAMETERS FOR LATENT CLASS "NO LD   "

           TIME 1
 BELOW GL  0.540
 ABOVE GL  0.460


 DELTA PARAMETERS FOR LATENT CLASS "MILD LD "

           TIME 1
 BELOW GL  0.711
 ABOVE GL  0.289


 DELTA PARAMETERS FOR LATENT CLASS "SEV LD  "

           TIME 1
 BELOW GL  0.640
 ABOVE GL  0.360

 **************************************************

 TAU PARAMETERS
 TAUS ARE PROBABILITIES OF LATENT STATUS MEMBERSHIP AT TIME T+1
(COLUMNS)
 CONDITIONAL ON LATENT STATUS MEMBERSHIP AT TIME T (ROWS)
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 AND ON LATENT CLASS MEMBERSHIP

TRANSITION PROBABILITIES FOR LATENT CLASS "NO LD   "

ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 1
COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2

        |  B  |  A  |
        |  E  |  B  |
        |  L  |  O  |
        |  O  |  V  |
        |  W  |  E  |
        |     |     |
        |  G  |  G  |
        |  L  |  L  |
BELOW GL 0.616 0.384
ABOVE GL 0.412 0.588

ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2
COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 3

        |  B  |  A  |
        |  E  |  B  |
        |  L  |  O  |
        |  O  |  V  |
        |  W  |  E  |
        |     |     |
        |  G  |  G  |
        |  L  |  L  |
BELOW GL 0.834 0.166
ABOVE GL 0.377 0.623

TRANSITION PROBABILITIES FOR LATENT CLASS "MILD LD "

ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 1
COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2

        |  B  |  A  |
        |  E  |  B  |
        |  L  |  O  |
        |  O  |  V  |
        |  W  |  E  |
        |     |     |
        |  G  |  G  |
        |  L  |  L  |
BELOW GL 0.715 0.285
ABOVE GL 0.295 0.705

ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2
COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 3

        |  B  |  A  |
        |  E  |  B  |
        |  L  |  O  |
        |  O  |  V  |
        |  W  |  E  |
        |     |     |
        |  G  |  G  |
        |  L  |  L  |
BELOW GL 0.700 0.300
ABOVE GL 0.460 0.540

TRANSITION PROBABILITIES FOR LATENT CLASS "SEV LD  "

ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 1
COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2

        |  B  |  A  |
        |  E  |  B  |
        |  L  |  O  |
        |  O  |  V  |
        |  W  |  E  |
        |     |     |
        |  G  |  G  |
        |  L  |  L  |
BELOW GL 0.663 0.337
ABOVE GL 0.395 0.605

ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2
COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 3

        |  B  |  A  |
        |  E  |  B  |
        |  L  |  O  |
        |  O  |  V  |
        |  W  |  E  |
        |     |     |
        |  G  |  G  |
        |  L  |  L  |
BELOW GL 0.772 0.228
ABOVE GL 0.307 0.693
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[6]

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**************************************************************
***  Standard Error Based on Data Augmentation             ***
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LITTLE RHO PARAMETERS
LITTLE RHOS ARE PROBABILITIES OF RESPONSES
TO ITEMS MEASURING THE STATIC LATENT VARIABLE
CONDITIONAL ON LATENT CLASS MEMBERSHIP

         RESPONSE CATEGORY  1

        | P N | P N | P N |
        | R O | R O | R O |
        | O   | O   | O   |
        | B   | B   | B   |
        | L   | L   | L   |
```

```
        | M   | M   | M   |
        | 1   | 2   | 3   |
        |     |     |     |
NO LD    0.012 0.021 0.021
MILD LD  0.012 0.021 0.021
SEV LD   0.006 0.021 0.021

         RESPONSE CATEGORY  2

        | P Y | P Y | P Y |
        | R E | R E | R E |
        | O S | O S | O S |
        | B   | B   | B   |
        | L   | L   | L   |
        | M   | M   | M   |
        | 1   | 2   | 3   |
        |     |     |     |
NO LD    0.006 0.021 0.021
MILD LD  0.006 0.021 0.021
SEV LD   0.006 0.021 0.021

         RESPONSE CATEGORY  3

        | P U | P   | P   |
        | R N | R   | R   |
        | O D | O   | O   |
        | B E | B   | B   |
        | L T | L   | L   |
        | M E | M   | M   |
        | 1 R | 2   | 3   |
        |   M |     |     |
NO LD    0.006   -     -
MILD LD  0.006   -     -
SEV LD   0.012   -     -


**************************************************

BIG RHO PARAMETERS
BIG RHOS ARE PROBABILITIES OF RESPONSES
TO ITEMS MEASURING THE DYNAMIC LATENT VARIABLE
CONDITIONAL ON LATENT STATUS, LATENT CLASS, AND TIME

         RHO PARAMETERS FOR LATENT CLASS "NO LD   " AT TIME  1

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.009 0.008 0.009
ABOVE GL 0.009 0.008 0.009

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.009 0.008 0.009
ABOVE GL 0.009 0.008 0.009

         RHO PARAMETERS FOR LATENT CLASS "NO LD   " AT TIME  2

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.009 0.008 0.009
ABOVE GL 0.009 0.008 0.009

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.009 0.008 0.009
ABOVE GL 0.009 0.008 0.009

         RHO PARAMETERS FOR LATENT CLASS "NO LD   " AT TIME  3

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
```

```
        |     |     |     |
BELOW GL 0.009 0.008 0.009
ABOVE GL 0.009 0.008 0.009

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.009 0.008 0.009
ABOVE GL 0.009 0.008 0.009

         RHO PARAMETERS FOR LATENT CLASS "MILD LD " AT TIME  1

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.009 0.008 0.009
ABOVE GL 0.009 0.008 0.009

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.009 0.008 0.009
ABOVE GL 0.009 0.008 0.009

         RHO PARAMETERS FOR LATENT CLASS "MILD LD " AT TIME  2

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.009 0.008 0.009
ABOVE GL 0.009 0.008 0.009

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.009 0.008 0.009
ABOVE GL 0.009 0.008 0.009

         RHO PARAMETERS FOR LATENT CLASS "MILD LD " AT TIME  3

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.009 0.008 0.009
ABOVE GL 0.009 0.008 0.009

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.009 0.008 0.009
ABOVE GL 0.009 0.008 0.009

         RHO PARAMETERS FOR LATENT CLASS "SEV LD  " AT TIME  1

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
```

```
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.009 0.008 0.009
ABOVE GL 0.009 0.008 0.009

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.009 0.008 0.009
ABOVE GL 0.009 0.008 0.009

         RHO PARAMETERS FOR LATENT CLASS "SEV LD  " AT TIME  2

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.009 0.008 0.009
ABOVE GL 0.009 0.008 0.009

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.009 0.008 0.009
ABOVE GL 0.009 0.008 0.009

         RHO PARAMETERS FOR LATENT CLASS "SEV LD  " AT TIME  3

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.009 0.008 0.009
ABOVE GL 0.009 0.008 0.009

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.009 0.008 0.009
ABOVE GL 0.009 0.008 0.009

 **************************************************

 GAMMA PARAMETERS
 GAMMAS ARE UNCONDITIONAL PROBABILITIES OF MEMBERSHIP IN EACH LATENT
CLASS
 OF THE STATIC LATENT VARIABLE

 NO LD     0.017
 MILD LD   0.015
 SEV LD    0.013

 **************************************************

 DELTA PARAMETERS
 DELTAS ARE PROBABILITIES OF LATENT STATUS MEMBERSHIP
  CONDITIONAL ON LATENT CLASS


 DELTA PARAMETERS FOR LATENT CLASS "NO LD   "

           TIME 1
 BELOW GL  0.025
 ABOVE GL  0.025


 DELTA PARAMETERS FOR LATENT CLASS "MILD LD "

           TIME 1
 BELOW GL  0.029
 ABOVE GL  0.029


 DELTA PARAMETERS FOR LATENT CLASS "SEV LD  "

           TIME 1
```

```
 BELOW GL  0.036
 ABOVE GL  0.036

 **************************************************

 TAU PARAMETERS
 TAUS ARE PROBABILITIES OF LATENT STATUS MEMBERSHIP AT TIME T+1
(COLUMNS)
 CONDITIONAL ON LATENT STATUS MEMBERSHIP AT TIME T (ROWS)
  AND ON LATENT CLASS MEMBERSHIP

 TRANSITION PROBABILITIES FOR LATENT CLASS "NO LD   "

 ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 1
 COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2

         |  B  |  A  |
         |  E  |  B  |
         |  L  |  O  |
         |  O  |  V  |
         |  W  |  E  |
         |     |     |
         |  G  |  G  |
         |  L  |  L  |
 BELOW GL 0.038 0.038
 ABOVE GL 0.046 0.046

 ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2
 COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 3

         |  B  |  A  |
         |  E  |  B  |
         |  L  |  O  |
         |  O  |  V  |
         |  W  |  E  |
         |     |     |
         |  G  |  G  |
         |  L  |  L  |
 BELOW GL 0.033 0.033
 ABOVE GL 0.041 0.041

 TRANSITION PROBABILITIES FOR LATENT CLASS "MILD LD "

 ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 1
 COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2

         |  B  |  A  |
         |  E  |  B  |
         |  L  |  O  |
         |  O  |  V  |
         |  W  |  E  |
         |     |     |
         |  G  |  G  |
         |  L  |  L  |
 BELOW GL 0.036 0.036
 ABOVE GL 0.067 0.067

 ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2
 COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 3

         |  B  |  A  |
         |  E  |  B  |
         |  L  |  O  |
         |  O  |  V  |
         |  W  |  E  |
         |     |     |
         |  G  |  G  |
         |  L  |  L  |
 BELOW GL 0.035 0.035
 ABOVE GL 0.049 0.049

 TRANSITION PROBABILITIES FOR LATENT CLASS "SEV LD  "

 ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 1
 COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2

         |  B  |  A  |
         |  E  |  B  |
         |  L  |  O  |
         |  O  |  V  |
         |  W  |  E  |
         |     |     |
         |  G  |  G  |
         |  L  |  L  |
 BELOW GL 0.058 0.058
 ABOVE GL 0.074 0.074

 ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2
 COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 3

         |  B  |  A  |
         |  E  |  B  |
         |  L  |  O  |
         |  O  |  V  |
         |  W  |  E  |
         |     |     |
         |  G  |  G  |
         |  L  |  L  |
 BELOW GL 0.048 0.048
 ABOVE GL 0.069 0.069
```

[7]

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**************************************************************
***  Lower Bound of 95% Confidence Interval                ***
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 **************************************************

 LITTLE RHO PARAMETERS
 LITTLE RHOS ARE PROBABILITIES OF RESPONSES
 TO ITEMS MEASURING THE STATIC LATENT VARIABLE
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CONDITIONAL ON LATENT CLASS MEMBERSHIP

         RESPONSE CATEGORY  1

        | P N | P N | P N |
        | R O | R O | R O |
        | O   | O   | O   |
        | B   | B   | B   |
        | L   | L   | L   |
        | M   | M   | M   |
        | 1   | 2   | 3   |
        |     |     |     |
NO LD    0.782 0.747 0.750
MILD LD  0.782 0.167 0.160
SEV LD   0.084 0.747 0.160

         RESPONSE CATEGORY  2

        | P Y | P Y | P Y |
        | R E | R E | R E |
        | O S | O S | O S |
        | B   | B   | B   |
        | L   | L   | L   |
        | M   | M   | M   |
        | 1   | 2   | 3   |
        |     |     |     |
NO LD    0.084 0.167 0.160
MILD LD  0.084 0.747 0.750
SEV LD   0.084 0.167 0.750

         RESPONSE CATEGORY  3

        | P U | P   | P   |
        | R N | R   | R   |
        | O D | O   | O   |
        | B E | B   | B   |
        | L T | L   | L   |
        | M E | M   | M   |
        | 1 R | 2   | 3   |
        |   M |     |     |
NO LD    0.084   -     -
MILD LD  0.084   -     -
SEV LD   0.782   -     -


**************************************************

BIG RHO PARAMETERS
BIG RHOS ARE PROBABILITIES OF RESPONSES
TO ITEMS MEASURING THE DYNAMIC LATENT VARIABLE
CONDITIONAL ON LATENT STATUS, LATENT CLASS, AND TIME

         RHO PARAMETERS FOR LATENT CLASS "NO LD    " AT TIME  1

         RESPONSE CATEGORY  1
```

```
        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.780 0.783 0.784
ABOVE GL 0.181 0.186 0.178

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.181 0.186 0.178
ABOVE GL 0.780 0.783 0.784

         RHO PARAMETERS FOR LATENT CLASS "NO LD    " AT TIME  2

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.780 0.783 0.784
ABOVE GL 0.181 0.186 0.178

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.181 0.186 0.178
ABOVE GL 0.780 0.783 0.784

         RHO PARAMETERS FOR LATENT CLASS "NO LD    " AT TIME  3
```

```
         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.780 0.783 0.784
ABOVE GL 0.181 0.186 0.178

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.181 0.186 0.178
ABOVE GL 0.780 0.783 0.784

         RHO PARAMETERS FOR LATENT CLASS "MILD LD " AT TIME  1

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.780 0.783 0.784
ABOVE GL 0.181 0.186 0.178

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.181 0.186 0.178
ABOVE GL 0.780 0.783 0.784

         RHO PARAMETERS FOR LATENT CLASS "MILD LD " AT TIME  2

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.780 0.783 0.784
ABOVE GL 0.181 0.186 0.178

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.181 0.186 0.178
ABOVE GL 0.780 0.783 0.784

         RHO PARAMETERS FOR LATENT CLASS "MILD LD " AT TIME  3

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.780 0.783 0.784
ABOVE GL 0.181 0.186 0.178

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.181 0.186 0.178
ABOVE GL 0.780 0.783 0.784
```

```
         RHO PARAMETERS FOR LATENT CLASS "SEV LD  " AT TIME  1

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.780 0.783 0.784
ABOVE GL 0.181 0.186 0.178

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.181 0.186 0.178
ABOVE GL 0.780 0.783 0.784

         RHO PARAMETERS FOR LATENT CLASS "SEV LD  " AT TIME  2

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.780 0.783 0.784
ABOVE GL 0.181 0.186 0.178

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.181 0.186 0.178
ABOVE GL 0.780 0.783 0.784
```

```
         RHO PARAMETERS FOR LATENT CLASS "SEV LD  " AT TIME  3

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.780 0.783 0.784
ABOVE GL 0.181 0.186 0.178

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.181 0.186 0.178
ABOVE GL 0.780 0.783 0.784

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GAMMA PARAMETERS
GAMMAS ARE UNCONDITIONAL PROBABILITIES OF MEMBERSHIP IN EACH LATENT
CLASS
OF THE STATIC LATENT VARIABLE

NO LD     0.357
MILD LD   0.379
SEV LD    0.175

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DELTA PARAMETERS
DELTAS ARE PROBABILITIES OF LATENT STATUS MEMBERSHIP
 CONDITIONAL ON LATENT CLASS


DELTA PARAMETERS FOR LATENT CLASS "NO LD   "

          TIME 1
BELOW GL  0.489
ABOVE GL  0.411


DELTA PARAMETERS FOR LATENT CLASS "MILD LD "
```

```
          TIME 1
 BELOW GL  0.646
 ABOVE GL  0.232


 DELTA PARAMETERS FOR LATENT CLASS "SEV LD  "

          TIME 1
 BELOW GL  0.564
 ABOVE GL  0.291

 **************************************************

 TAU PARAMETERS
 TAUS ARE PROBABILITIES OF LATENT STATUS MEMBERSHIP AT TIME T+1
(COLUMNS)
 CONDITIONAL ON LATENT STATUS MEMBERSHIP AT TIME T (ROWS)
  AND ON LATENT CLASS MEMBERSHIP

 TRANSITION PROBABILITIES FOR LATENT CLASS "NO LD   "

 ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 1
 COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2

        |  B  |  A  |
        |  E  |  B  |
        |  L  |  O  |
        |  O  |  V  |
        |  W  |  E  |
        |     |     |
        |  G  |  G  |
        |  L  |  L  |
 BELOW GL 0.533 0.307
 ABOVE GL 0.320 0.490

 ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2
 COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 3

        |  B  |  A  |
        |  E  |  B  |
        |  L  |  O  |
        |  O  |  V  |
        |  W  |  E  |
        |     |     |
        |  G  |  G  |
        |  L  |  L  |
 BELOW GL 0.754 0.106
 ABOVE GL 0.297 0.537

 TRANSITION PROBABILITIES FOR LATENT CLASS "MILD LD "

 ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 1
 COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2

        |  B  |  A  |
        |  E  |  B  |
        |  L  |  O  |
        |  O  |  V  |
        |  W  |  E  |
        |     |     |
        |  G  |  G  |
        |  L  |  L  |
 BELOW GL 0.631 0.213
 ABOVE GL 0.171 0.548

 ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2
 COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 3

        |  B  |  A  |
        |  E  |  B  |
        |  L  |  O  |
        |  O  |  V  |
        |  W  |  E  |
        |     |     |
        |  G  |  G  |
        |  L  |  L  |
 BELOW GL 0.622 0.232
 ABOVE GL 0.360 0.438

 TRANSITION PROBABILITIES FOR LATENT CLASS "SEV LD  "

 ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 1
 COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2

        |  B  |  A  |
        |  E  |  B  |
        |  L  |  O  |
        |  O  |  V  |
        |  W  |  E  |
        |     |     |
        |  G  |  G  |
        |  L  |  L  |
 BELOW GL 0.525 0.219
 ABOVE GL 0.250 0.442

 ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2
 COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 3

        |  B  |  A  |
        |  E  |  B  |
        |  L  |  O  |
        |  O  |  V  |
        |  W  |  E  |
        |     |     |
        |  G  |  G  |
        |  L  |  L  |
 BELOW GL 0.661 0.143
 ABOVE GL 0.179 0.532
```

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8***************************************************************
 ***  Upper Bound of 95% Confidence Interval                 ***
 ***************************************************************

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 LITTLE RHO PARAMETERS
 LITTLE RHOS ARE PROBABILITIES OF RESPONSES
 TO ITEMS MEASURING THE STATIC LATENT VARIABLE
 CONDITIONAL ON LATENT CLASS MEMBERSHIP

          RESPONSE CATEGORY  1

         | P N | P N | P N |
         | R O | R O | R O |
         | O   | O   | O   |
         | B   | B   | B   |
         | L   | L   | L   |
         | M   | M   | M   |
         | 1   | 2   | 3   |
         |     |     |     |
 NO LD    0.832 0.833 0.840
 MILD LD  0.832 0.253 0.250
 SEV LD   0.109 0.833 0.250

          RESPONSE CATEGORY  2

         | P Y | P Y | P Y |
         | R E | R E | R E |
         | O S | O S | O S |
         | B   | B   | B   |
         | L   | L   | L   |
         | M   | M   | M   |
         | 1   | 2   | 3   |
         |     |     |     |
 NO LD    0.109 0.253 0.250
 MILD LD  0.109 0.833 0.840
 SEV LD   0.109 0.253 0.840

          RESPONSE CATEGORY  3

         | P U | P   | P   |
         | R N | R   | R   |
         | O D | O   | O   |
         | B E | B   | B   |
         | L T | L   | L   |
         | M E | M   | M   |
         | 1 R | 2   | 3   |
         |   M |     |     |
 NO LD    0.109   -     -
 MILD LD  0.109   -     -
 SEV LD   0.832   -     -


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BIG RHO PARAMETERS
BIG RHOS ARE PROBABILITIES OF RESPONSES
TO ITEMS MEASURING THE DYNAMIC LATENT VARIABLE
CONDITIONAL ON LATENT STATUS, LATENT CLASS, AND TIME

         RHO PARAMETERS FOR LATENT CLASS "NO LD    " AT TIME  1

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.819 0.814 0.822
ABOVE GL 0.220 0.217 0.216

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.220 0.217 0.216
ABOVE GL 0.819 0.814 0.822

         RHO PARAMETERS FOR LATENT CLASS "NO LD    " AT TIME  2

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.819 0.814 0.822
ABOVE GL 0.220 0.217 0.216

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
```

```
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.220 0.217 0.216
ABOVE GL 0.819 0.814 0.822

         RHO PARAMETERS FOR LATENT CLASS "NO LD   " AT TIME  3

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.819 0.814 0.822
ABOVE GL 0.220 0.217 0.216

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.220 0.217 0.216
ABOVE GL 0.819 0.814 0.822

         RHO PARAMETERS FOR LATENT CLASS "MILD LD " AT TIME  1

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.819 0.814 0.822
ABOVE GL 0.220 0.217 0.216

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.220 0.217 0.216
ABOVE GL 0.819 0.814 0.822

         RHO PARAMETERS FOR LATENT CLASS "MILD LD " AT TIME  2

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.819 0.814 0.822
ABOVE GL 0.220 0.217 0.216

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.220 0.217 0.216
ABOVE GL 0.819 0.814 0.822

         RHO PARAMETERS FOR LATENT CLASS "MILD LD " AT TIME  3

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.819 0.814 0.822
ABOVE GL 0.220 0.217 0.216

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
```

```
         | T O | A O | I O |
         | H V | D V | E V |
         |   E | I E | N E |
         |     | N   | C   |
         |     | G   | E   |
         |     |     |     |
BELOW GL 0.220 0.217 0.216
ABOVE GL 0.819 0.814 0.822

         RHO PARAMETERS FOR LATENT CLASS "SEV LD  " AT TIME  1

         RESPONSE CATEGORY  1

         | M B | R B | S B |
         | A E | E E | C E |
         | T L | A L | I L |
         | H O | D O | E O |
         |   W | I W | N W |
         |     | N   | C   |
         |     | G   | E   |
         |     |     |     |
BELOW GL 0.819 0.814 0.822
ABOVE GL 0.220 0.217 0.216

         RESPONSE CATEGORY  2

         | M A | R A | S A |
         | A B | E B | C B |
         | T O | A O | I O |
         | H V | D V | E V |
         |   E | I E | N E |
         |     | N   | C   |
         |     | G   | E   |
         |     |     |     |
BELOW GL 0.220 0.217 0.216
ABOVE GL 0.819 0.814 0.822

         RHO PARAMETERS FOR LATENT CLASS "SEV LD  " AT TIME  2

         RESPONSE CATEGORY  1

         | M B | R B | S B |
         | A E | E E | C E |
         | T L | A L | I L |
         | H O | D O | E O |
         |   W | I W | N W |
         |     | N   | C   |
         |     | G   | E   |
         |     |     |     |
BELOW GL 0.819 0.814 0.822
ABOVE GL 0.220 0.217 0.216

         RESPONSE CATEGORY  2

         | M A | R A | S A |
         | A B | E B | C B |
         | T O | A O | I O |
         | H V | D V | E V |
         |   E | I E | N E |
         |     | N   | C   |
         |     | G   | E   |
         |     |     |     |
BELOW GL 0.220 0.217 0.216
ABOVE GL 0.819 0.814 0.822

         RHO PARAMETERS FOR LATENT CLASS "SEV LD  " AT TIME  3

         RESPONSE CATEGORY  1

         | M B | R B | S B |
         | A E | E E | C E |
         | T L | A L | I L |
         | H O | D O | E O |
         |   W | I W | N W |
         |     | N   | C   |
         |     | G   | E   |
         |     |     |     |
BELOW GL 0.819 0.814 0.822
ABOVE GL 0.220 0.217 0.216

         RESPONSE CATEGORY  2

         | M A | R A | S A |
         | A B | E B | C B |
         | T O | A O | I O |
         | H V | D V | E V |
         |   E | I E | N E |
         |     | N   | C   |
         |     | G   | E   |
         |     |     |     |
BELOW GL 0.220 0.217 0.216
ABOVE GL 0.819 0.814 0.822

 **************************************************

 GAMMA PARAMETERS
 GAMMAS ARE UNCONDITIONAL PROBABILITIES OF MEMBERSHIP IN EACH LATENT
CLASS
 OF THE STATIC LATENT VARIABLE

 NO LD      0.426
 MILD LD    0.440
 SEV LD     0.226

 **************************************************

 DELTA PARAMETERS
 DELTAS ARE PROBABILITIES OF LATENT STATUS MEMBERSHIP
  CONDITIONAL ON LATENT CLASS
```

```
 DELTA PARAMETERS FOR LATENT CLASS "NO LD   "

           TIME 1
 BELOW GL  0.590
 ABOVE GL  0.510


 DELTA PARAMETERS FOR LATENT CLASS "MILD LD "

           TIME 1
 BELOW GL  0.771
 ABOVE GL  0.349


 DELTA PARAMETERS FOR LATENT CLASS "SEV LD  "

           TIME 1
 BELOW GL  0.713
 ABOVE GL  0.434

 **************************************************

 TAU PARAMETERS
 TAUS ARE PROBABILITIES OF LATENT STATUS MEMBERSHIP AT TIME T+1
(COLUMNS)
 CONDITIONAL ON LATENT STATUS MEMBERSHIP AT TIME T (ROWS)
  AND ON LATENT CLASS MEMBERSHIP

 TRANSITION PROBABILITIES FOR LATENT CLASS "NO LD   "

 ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 1
 COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2

         |  B  |  A  |
         |  E  |  B  |
         |  L  |  O  |
         |  O  |  V  |
         |  W  |  E  |
         |     |     |
         |  G  |  G  |
         |  L  |  L  |
 BELOW GL 0.693 0.467
 ABOVE GL 0.510 0.680

 ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2
 COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 3

         |  B  |  A  |
         |  E  |  B  |
         |  L  |  O  |
         |  O  |  V  |
         |  W  |  E  |
         |     |     |
         |  G  |  G  |
```

```
        |  L  |  L  |
BELOW GL 0.894 0.246
ABOVE GL 0.463 0.703

TRANSITION PROBABILITIES FOR LATENT CLASS "MILD LD "

ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 1
COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2

        |  B  |  A  |
        |  E  |  B  |
        |  L  |  O  |
        |  O  |  V  |
        |  W  |  E  |
        |     |     |
        |  G  |  G  |
        |  L  |  L  |
BELOW GL 0.787 0.369
ABOVE GL 0.452 0.829

ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2
COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 3

        |  B  |  A  |
        |  E  |  B  |
        |  L  |  O  |
        |  O  |  V  |
        |  W  |  E  |
        |     |     |
        |  G  |  G  |
        |  L  |  L  |
BELOW GL 0.768 0.378
ABOVE GL 0.562 0.640

TRANSITION PROBABILITIES FOR LATENT CLASS "SEV LD  "

ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 1
COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2

        |  B  |  A  |
        |  E  |  B  |
        |  L  |  O  |
        |  O  |  V  |
        |  W  |  E  |
        |     |     |
        |  G  |  G  |
        |  L  |  L  |
BELOW GL 0.781 0.475
ABOVE GL 0.558 0.750

ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2
COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 3

        |  B  |  A  |
        |  E  |  B  |
```

```
        |  L  |  O  |
        |  O  |  V  |
        |  W  |  E  |
        |     |     |
        |  G  |  G  |
        |  L  |  L  |
BELOW GL 0.857 0.339
ABOVE GL 0.468 0.821
```

9
```
**************************************************************
***  Fraction of Missing Information                       ***
**************************************************************

**************************************************

LITTLE RHO PARAMETERS
LITTLE RHOS ARE PROBABILITIES OF RESPONSES
TO ITEMS MEASURING THE STATIC LATENT VARIABLE
CONDITIONAL ON LATENT CLASS MEMBERSHIP

         RESPONSE CATEGORY  1

        | P N | P N | P N |
        | R O | R O | R O |
        | O   | O   | O   |
        | B   | B   | B   |
        | L   | L   | L   |
        | M   | M   | M   |
        | 1   | 2   | 3   |
        |     |     |     |
NO LD    0.522 0.829 0.839
MILD LD  0.522 0.829 0.839
SEV LD   0.493 0.829 0.839

         RESPONSE CATEGORY  2

        | P Y | P Y | P Y |
        | R E | R E | R E |
        | O S | O S | O S |
        | B   | B   | B   |
        | L   | L   | L   |
        | M   | M   | M   |
        | 1   | 2   | 3   |
        |     |     |     |
NO LD    0.493 0.829 0.839
MILD LD  0.493 0.829 0.839
SEV LD   0.493 0.829 0.839

         RESPONSE CATEGORY  3

        | P U | P   | P   |
        | R N | R   | R   |
        | O D | O   | O   |
        | B E | B   | B   |
        | L T | L   | L   |
        | M E | M   | M   |
        | 1 R | 2   | 3   |
        |   M |     |     |
NO LD    0.493   -     -
MILD LD  0.493   -     -
SEV LD   0.522   -     -


**************************************************

BIG RHO PARAMETERS
BIG RHOS ARE PROBABILITIES OF RESPONSES
TO ITEMS MEASURING THE DYNAMIC LATENT VARIABLE
CONDITIONAL ON LATENT STATUS, LATENT CLASS, AND TIME

         RHO PARAMETERS FOR LATENT CLASS "NO LD   " AT TIME  1

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.709 0.556 0.713
ABOVE GL 0.709 0.556 0.713

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.709 0.556 0.713
ABOVE GL 0.709 0.556 0.713

         RHO PARAMETERS FOR LATENT CLASS "NO LD   " AT TIME  2

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
```

```
BELOW GL 0.709 0.556 0.713
ABOVE GL 0.709 0.556 0.713

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.709 0.556 0.713
ABOVE GL 0.709 0.556 0.713

         RHO PARAMETERS FOR LATENT CLASS "NO LD   " AT TIME  3

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.709 0.556 0.713
ABOVE GL 0.709 0.556 0.713

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.709 0.556 0.713
ABOVE GL 0.709 0.556 0.713

         RHO PARAMETERS FOR LATENT CLASS "MILD LD " AT TIME  1

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
```

```
        |     |     |     |
BELOW GL 0.709 0.556 0.713
ABOVE GL 0.709 0.556 0.713

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.709 0.556 0.713
ABOVE GL 0.709 0.556 0.713

         RHO PARAMETERS FOR LATENT CLASS "MILD LD " AT TIME  2

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.709 0.556 0.713
ABOVE GL 0.709 0.556 0.713

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.709 0.556 0.713
ABOVE GL 0.709 0.556 0.713

         RHO PARAMETERS FOR LATENT CLASS "MILD LD " AT TIME  3

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
```

```
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.709 0.556 0.713
ABOVE GL 0.709 0.556 0.713

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.709 0.556 0.713
ABOVE GL 0.709 0.556 0.713

         RHO PARAMETERS FOR LATENT CLASS "SEV LD  " AT TIME  1

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.709 0.556 0.713
ABOVE GL 0.709 0.556 0.713

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.709 0.556 0.713
ABOVE GL 0.709 0.556 0.713

         RHO PARAMETERS FOR LATENT CLASS "SEV LD  " AT TIME  2

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.709 0.556 0.713
ABOVE GL 0.709 0.556 0.713

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.709 0.556 0.713
ABOVE GL 0.709 0.556 0.713

         RHO PARAMETERS FOR LATENT CLASS "SEV LD  " AT TIME  3

         RESPONSE CATEGORY  1

        | M B | R B | S B |
        | A E | E E | C E |
        | T L | A L | I L |
        | H O | D O | E O |
        |   W | I W | N W |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.709 0.556 0.713
ABOVE GL 0.709 0.556 0.713

         RESPONSE CATEGORY  2

        | M A | R A | S A |
        | A B | E B | C B |
        | T O | A O | I O |
        | H V | D V | E V |
        |   E | I E | N E |
        |     | N   | C   |
        |     | G   | E   |
        |     |     |     |
BELOW GL 0.709 0.556 0.713
ABOVE GL 0.709 0.556 0.713

**************************************************

GAMMA PARAMETERS
GAMMAS ARE UNCONDITIONAL PROBABILITIES OF MEMBERSHIP IN EACH LATENT
CLASS
OF THE STATIC LATENT VARIABLE

NO LD     0.598
```

```
 MILD LD   0.504
 SEV LD    0.523

 **************************************************

 DELTA PARAMETERS
 DELTAS ARE PROBABILITIES OF LATENT STATUS MEMBERSHIP
  CONDITIONAL ON LATENT CLASS


 DELTA PARAMETERS FOR LATENT CLASS "NO LD   "

           TIME 1
 BELOW GL  0.507
 ABOVE GL  0.507


 DELTA PARAMETERS FOR LATENT CLASS "MILD LD "

           TIME 1
 BELOW GL  0.723
 ABOVE GL  0.723


 DELTA PARAMETERS FOR LATENT CLASS "SEV LD  "

           TIME 1
 BELOW GL  0.582
 ABOVE GL  0.582

 **************************************************

 TAU PARAMETERS
 TAUS ARE PROBABILITIES OF LATENT STATUS MEMBERSHIP AT TIME T+1
(COLUMNS)
 CONDITIONAL ON LATENT STATUS MEMBERSHIP AT TIME T (ROWS)
  AND ON LATENT CLASS MEMBERSHIP

 TRANSITION PROBABILITIES FOR LATENT CLASS "NO LD   "

 ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 1
 COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2

         |  B  |  A  |
         |  E  |  B  |
         |  L  |  O  |
         |  O  |  V  |
         |  W  |  E  |
         |     |     |
         |  G  |  G  |
         |  L  |  L  |
 BELOW GL 0.652 0.652
 ABOVE GL 0.709 0.709

 ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2
 COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 3

         |  B  |  A  |
         |  E  |  B  |
         |  L  |  O  |
         |  O  |  V  |
         |  W  |  E  |
         |     |     |
         |  G  |  G  |
         |  L  |  L  |
 BELOW GL 0.726 0.726
 ABOVE GL 0.648 0.648

 TRANSITION PROBABILITIES FOR LATENT CLASS "MILD LD "

 ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 1
 COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2

         |  B  |  A  |
         |  E  |  B  |
         |  L  |  O  |
         |  O  |  V  |
         |  W  |  E  |
         |     |     |
         |  G  |  G  |
         |  L  |  L  |
 BELOW GL 0.763 0.763
 ABOVE GL 0.832 0.832

 ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2
 COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 3

         |  B  |  A  |
         |  E  |  B  |
         |  L  |  O  |
         |  O  |  V  |
         |  W  |  E  |
         |     |     |
         |  G  |  G  |
         |  L  |  L  |
 BELOW GL 0.679 0.679
 ABOVE GL 0.717 0.717

 TRANSITION PROBABILITIES FOR LATENT CLASS "SEV LD  "

 ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 1
 COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2

         |  B  |  A  |
         |  E  |  B  |
         |  L  |  O  |
         |  O  |  V  |
         |  W  |  E  |
         |     |     |
         |  G  |  G  |
```

```
        |  L  |  L  |
BELOW GL 0.771 0.771
ABOVE GL 0.729 0.729

ROWS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 2
COLUMNS REPRESENT LATENT STATUS MEMBERSHIP AT TIME 3

        |  B  |  A  |
        |  E  |  B  |
        |  L  |  O  |
        |  O  |  V  |
        |  W  |  E  |
        |     |     |
        |  G  |  G  |
        |  L  |  L  |
BELOW GL 0.689 0.689
ABOVE GL 0.773 0.773

PROGRAM FINISHED:       Fri Mar 29 17:16:10 2002
ELAPSED TIME:    0 HOURS,    0 MINUTES,   34 SECONDS.
```

EXPLANATION OF THE DA OUTPUT FROM WinLTA FOR EXAMPLE 3

The following sections refer to output given by the program using the example control file. The first sections of the output echo the parameter restrictions, starting values, and other information that was used in the prior EM estimation. Following that are the DA results.

Program Control File Information

1 The title lines and comments entered in the General tab will be printed first.

2 Basic information from the Model and Data tab and the Estimation tab is echoed back in this section of the output file. This information includes the number of latent classes, number of latent statuses, number of items (for statuses and classes), number of occasions of measurement, number of participants, number of observed response patterns, number of iterations between imputations, number of imputations, the random number generator seed, and whether there is missing data in the observed response patterns.

3 The parameter restrictions are echoed here. DA should use the same parameter restrictions that were used in the EM estimation.

4 The starting values are echoed here. Starting values for DA are the final parameter estimates that were obtained in the EM run. These estimates are contained in file selected on the Data Augmentation tab in the starting values file (from EM run).

DA Results

The remainder of the DA output file contains five sections, each which reports statistics for the entire set of parameters. For brevity we will discuss findings related to the gamma parameters.

5 Final Parameter Estimates Based on Data Augmentation: This section reports the final parameter estimates. In Example 3, the gamma parameters show that we expect 39.1% of the sample to be in the ‘no learning disability’ latent class, 40.9% to be in the ‘mild learning disability’ latent class, and 20.0% to be in the ‘severe learning disability’ latent class.

6 Standard Error Based on Data Augmentation: This section reports the standard error associated with each of the final parameter estimates. The standard errors associated with each of the above gamma parameters are 0.017, 0.014 and 0.015, respectively.

7 Lower Bound of 95% Confidence Interval: Confidence intervals based on the final parameter estimates and their associated standard errors are calculated for each parameter. These intervals were created in the logit metric and transformed back to the probability scale, therefore estimates near the boundaries (0 and 1) will have asymmetric confidence intervals. This section reports the lower bound of the confidence interval. The lower bound for the gamma parameters are 35.7%, 37.9% and 17.5%, respectively

[8] **Upper Bound of 95% Confidence Interval:** This section reports the upper bound of the confidence interval for each parameter. The upper bound for the gamma parameters are 42.6%, 44.0% and 22.6%, respectively. Thus, the 95% confidence interval for the first gamma parameter is [35.7%, 42.6%]. This gives us an idea of the amount of uncertainty associated with this parameter estimate.

[9] **Fraction of Missing Information:** This section reports the fraction of missing information associated with each DA parameter estimate. The fraction of missing information associated with each of the gamma parameters is .598, .504 and .523, respectively.

Note that if the user specifies a parameter as freely estimated but no estimation actually takes place, the following DA output will be displayed for that parameter: The starting value will be displayed as the final parameter estimate; the standard error will be 0; and the bounds of the 95% confidence interval and the fraction of missing information will show 'UND' to represent an undefined value. An example of such a parameter might be a tau parameter where all other tau parameters in the row of that transition probability matrix are fixed. Because all tau parameters in one row must sum to 1, no estimation takes place and this parameter is treated as fixed to the starting value.

RESULTS OF A SIMULATION STUDY

A study was done to examine how parameter estimates and confidence intervals based on DA compare to known parameter values for a particular latent transition model using WinLTA 3.0. A simulation was conducted in order to assess the bias of parameter estimates, the bias of their associated standard errors, and the coverage of the associated 95% confidence intervals. Coverage refers to the frequency that a parameter's confidence interval contains the true parameter. We investigated conditions under which the DA procedure can successfully recover parameters in the long run by varying sample size, the strength of the measurement parameters, the presence of missing data, and the number of imputations. Details related to the design and results of this simulation appear in Hyatt, Collins, and Schafer (1999).

The model used in the simulation study was based on several recent empirical studies using LTA to examine factors relating to adolescent substance use onset (see Hyatt & Collins, 1999). This model involves stage-sequential development over two times of measurement. Five dichotomous indicators of the latent status were posited, and eight latent statuses were specified. For each combination of the factors listed below, 1000 random multivariate datasets were generated from a population with known parameters. Four factors were varied in this study: sample size (N=300 and N=1000), the strength of the measurement parameters (.1 and .9 versus .3 and .7), the presence of missing data (0% versus 12%), and the number of imputed datasets (5 versus 10). Each dataset was estimated via the EM algorithm, and these parameter estimates were used as the starting values for DA.

The results of this study suggest that the use of DA to estimate standard errors of parameters for LTA models is appropriate and useful when the ρ parameters are strong. Small sample sizes, missing data, and weak measurement parameters are conditions which reflect a lack of information, whereas large sample sizes, no missing data, and strong measurement parameters are conditions which indicate that there is more available information. Under poor conditions there many not be enough information to apply DA with confidence.

In general, parameter estimates based on DA are more biased than the maximum-likelihood estimates. However, conditions involving strong ρ parameters usually yield results that are not substantially biased and that have reasonable coverage. A larger sample size also appears to produce slightly less biased parameter estimates and better coverage. The presence of missing data did not appear to reduce the performance of DA substantially. Increasing the number of imputations from 5 to 10 did not substantially improve the performance of DA in LTA.

At this time we can confidently recommend the use of DA for obtaining estimates of standard errors in latent transition models involving strong measurement parameters. In order to have the highest level of confidence when estimating standard errors in latent transition models, one should have strong ρ parameters and a large sample size. Even with the smaller sample size, bias was small and coverage was adequate in most cases when the ρ parameters were strong. Until more research is conducted on the use of DA with weak ρ parameters, however, we recommend that the procedure not be used when the measurement is not strong. Users can base this decision on the results provided by the EM algorithm. One check that users can perform to ensure that results based on DA are clearly interpretable is to examine the pattern of the ρ parameters from each imputation and verify that they are consistent.

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