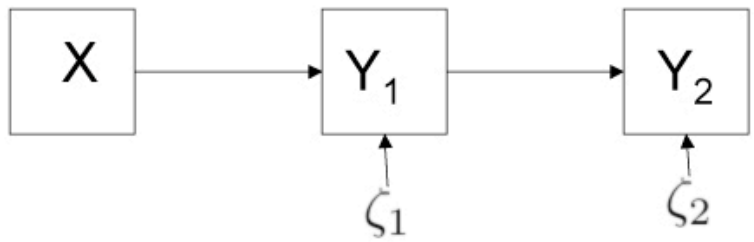
Introduction to SAS `proc calis`

```
/* path1.sas */
%include 'SenicRead.sas';
title2 'Path Analysis Example for 3 Observed Variables';

/*********************************************************************
*                                                                    *
* Cases are hospitals                                                *
*                                                                    *
*        stay     Average length of stay in days.                    *
*        infrisk  Estimated probability of getting a respiratory     *
*                 infection in hospital.                             *
*        xratio   Chest X-rays of patients with no sign of pneumonia *
*********************************************************************/

proc calis cov;          /* Analyze the covariance matrix (Default is corr) */
     title3 'Stay -> Infrisk -> Xratio';
     var stay infrisk xratio;  /* Observed vars are in the data set */
     lineqs              /* Simultaneous equations, separated by commas */
          infrisk = gamma stay + e1,
          xratio  = beta infrisk + e2;
     std                  /* Variances (not standard deviations) */
          stay = phi,
          e1 = psi1,
          e2 = psi2;
     /* Specify covariances of exogenous vars with the cov
        statement. Unmentioned pairs get covariance zero.  */

     bounds 0.0 < phi psi1 psi2; /* Variances are greater than zero */

proc calis cov;
     title3 'Backwards: Xratio -> Infrisk -> Stay';
     var stay infrisk xratio;
     lineqs
          infrisk = gamma xratio + e1,
          stay  = beta infrisk + e2;
     std                  /* Variances (not standard deviations) */
          xratio = phi,
          e1 = psi1,
          e2 = psi2;

bounds 0.0 < phi psi1 psi2; /* Variances are greater than zero */

proc calis cov;
     title3 'Just Identified (Saturated) Model';
     var stay infrisk xratio;
     lineqs
          infrisk = gamma1 stay + e1,
          xratio  = gamma2 stay + beta infrisk + e2;
     std                  /* Variances (not standard deviations) */
          stay = phi,
          e1 = psi1,
          e2 = psi2;

     bounds 0.0 < phi psi1 psi2; /* Variances are greater than zero */
```



$$
\begin{aligned}
Y_1 &= \gamma X + \zeta_1 \\
Y_2 &= \beta Y_1 + \zeta_2
\end{aligned}
$$

$E(X) = E(\zeta_1) = E(\zeta_2) = 0$

$V(X) = \phi, V(\zeta_1) = \psi_1, V(\zeta_2) = \psi_2$

X, ζ_1, ζ_2 are independent

Everything is normal

```
proc calis cov;          /* Analyze the covariance matrix (Default is corr) */
     title3 'Stay -> Infrisk -> Xratio';
     var stay infrisk xratio;  /* Observed vars are in the data set */
     lineqs              /* Simultaneous equations, separated by commas */
          infrisk = gamma stay + e1,
          xratio  = beta infrisk + e2;
     std                  /* Variances (not standard deviations) */
          stay = phi,
          e1 = psi1,
          e2 = psi2;
     /* Specify covariances of exogenous vars with the cov
        statement. Unmentioned pairs get covariance zero.  */

     bounds 0.0 < phi psi1 psi2; /* Variances are greater than zero */
```

```
       Study of the Efficacy of Nosocomial Infection Control (SENIC)        1
              Path Analysis Example for 3 Observed Variables
                         Stay -> Infrisk -> Xratio

                            The CALIS Procedure
         Covariance Structure Analysis: Pattern and Initial Values

                          LINEQS Model Statement


                     Matrix      Rows    Columns    ------Matrix Type-------

Term 1          1    _SEL_          3          5    SELECTION
                2    _BETA_         5          5    EQSBETA        IMINUSINV
                3    _GAMMA_        5          3    EQSGAMMA
                4    _PHI_          3          3    SYMMETRIC


                       The 2 Endogenous Variables

    Manifest        infrisk  xratio
    Latent


                       The 3 Exogenous Variables

    Manifest        stay
    Latent
    Error           e1       e2
```

```
       Study of the Efficacy of Nosocomial Infection Control (SENIC)        2
              Path Analysis Example for 3 Observed Variables
                         Stay -> Infrisk -> Xratio

                            The CALIS Procedure
         Covariance Structure Analysis: Pattern and Initial Values

            Manifest Variable Equations with Initial Estimates


               infrisk =        .*stay    +  1.0000 e1
                                  gamma
               xratio  =        .*infrisk +  1.0000 e2
                                  beta


                     Variances of Exogenous Variables

                     Variable Parameter      Estimate

                     stay     phi                  .
                     e1       psi1                 .
                     e2       psi2                 .
```

Path Analysis Example for 3 Observed Variables

Stay -> Infrisk -> Xratio

The CALIS Procedure

Covariance Structure Analysis: Maximum Likelihood Estimation

Observations	113	Model Terms	1
Variables	3	Model Matrices	4
Informations	6	Parameters	5

Variable		Mean	Std Dev
stay	Av length of hospital stay, in days	9.64832	1.91146
infrisk	Prob of acquiring infection in hospital	4.35487	1.34091
xratio	# x-rays / # no signs of pneumonia	81.63009	19.36674

Set Covariances of Exogenous Manifest Variables

stay

NOTE: Some initial estimates computed by two-stage LS method.

Path Analysis Example for 3 Observed Variables

Stay -> Infrisk -> Xratio

The CALIS Procedure

Covariance Structure Analysis: Maximum Likelihood Estimation

Vector of Initial Estimates

	Parameter	Estimate	Type
1	beta	10.35236	Matrix Entry: _BETA_[2:1]
2	gamma	0.37422	Matrix Entry: _GAMMA_[1:1]
3	phi	3.65366	Matrix Entry: _PHI_[1:1]
4	psi1	1.28638	Matrix Entry: _PHI_[2:2]
5	psi2	324.04169	Matrix Entry: _PHI_[3:3]

Path Analysis Example for 3 Observed Variables

Stay -> Infrisk -> Xratio

The CALIS Procedure

Covariance Structure Analysis: Maximum Likelihood Estimation

Levenberg-Marquardt Optimization

Scaling Update of More (1978)

Parameter Estimates	5
Functions (Observations)	6
Lower Bounds	3
Upper Bounds	0

Optimization Start

Active Constraints	0	Objective Function	0.1191390524
Max Abs Gradient Element	0.0422313093	Radius	1

Iter	Restarts	Func Calls	Act Con	Objective Function	Obj Fun Change	Max Abs Gradient Element	Lambda	Actual Over Pred Change
1	0	2	0	0.03878	0.0804	0.000248	0	1.000
2	0	3	0	0.03537	0.00341	1.15E-15	0	1.057

Optimization Results

Iterations	2	Function Calls	4
Jacobian Calls	3	Active Constraints	0
Objective Function	0.0353716706	Max Abs Gradient Element	1.150916E-15
Lambda	0	Actual Over Pred Change	1.0570208096
Radius	0.1607096852		

ABSGCONV convergence criterion satisfied.

Path Analysis Example for 3 Observed Variables

Stay -> Infrisk -> Xratio

The CALIS Procedure

Covariance Structure Analysis: Maximum Likelihood Estimation

Fit Function	0.0354
Goodness of Fit Index (GFI)	0.9774
GFI Adjusted for Degrees of Freedom (AGFI)	0.8641
Root Mean Square Residual (RMR)	2.1241
Parsimonious GFI (Mulaik, 1989)	0.3258
Chi-Square	3.9616
Chi-Square DF	1
Pr > Chi-Square	0.0465
Independence Model Chi-Square	67.227
Independence Model Chi-Square DF	3
RMSEA Estimate	0.1626
RMSEA 90% Lower Confidence Limit	0.0168
RMSEA 90% Upper Confidence Limit	0.3435
ECVI Estimate	0.1280
ECVI 90% Lower Confidence Limit	.
ECVI 90% Upper Confidence Limit	0.2218
Probability of Close Fit	0.0779
Bentler's Comparative Fit Index	0.9539
Normal Theory Reweighted LS Chi-Square	3.8924
Akaike's Information Criterion	1.9616
Bozdogan's (1987) CAIC	-1.7658
Schwarz's Bayesian Criterion	-0.7658
McDonald's (1989) Centrality	0.9870
Bentler & Bonett's (1980) Non-normed Index	0.8617
Bentler & Bonett's (1980) NFI	0.9411
James, Mulaik, & Brett (1982) Parsimonious NFI	0.3137
Z-Test of Wilson & Hilferty (1931)	1.7067
Bollen (1986) Normed Index Rho1	0.8232
Bollen (1988) Non-normed Index Delta2	0.9553
Hoelter's (1983) Critical N	110

Path Analysis Example for 3 Observed Variables
Stay -> Infrisk -> Xratio

The CALIS Procedure
Covariance Structure Analysis: Maximum Likelihood Estimation

Manifest Variable Equations with Estimates

```
infrisk =   0.3742*stay     +  1.0000 e1
Std Err     0.0561 gamma
t Value     6.6744
xratio  =   6.5469*infrisk  +  1.0000 e2
Std Err     1.2165 beta
t Value     5.3819
```

Variances of Exogenous Variables

Variable	Parameter	Estimate	Standard Error	t Value
stay	phi	3.65366	0.48824	7.48
e1	psi1	1.28638	0.17190	7.48
e2	psi2	298.00337	39.82238	7.48

Path Analysis Example for 3 Observed Variables
Stay -> Infrisk -> Xratio

The CALIS Procedure
Covariance Structure Analysis: Maximum Likelihood Estimation

Manifest Variable Equations with Standardized Estimates

```
infrisk =   0.5334*stay    +  0.8458 e1
                   gamma
xratio  =   0.4533*infrisk +  0.8914 e2
                   beta
```

Squared Multiple Correlations

	Variable	Error Variance	Total Variance	R-Square
1	infrisk	1.28638	1.79803	0.2846
2	xratio	298.00337	375.07052	0.2055

For the fairly reasonable forwards path model, the Likelihood Ratio test for goodness of fit yields chisquare = 3.9616. For the bone-headed backwards model, we get

---

```
         Study of the Efficacy of Nosocomial Infection Control (SENIC)       14
                Path Analysis Example for 3 Observed Variables
                     Backwards: Xratio -> Infrisk -> Stay

                          The CALIS Procedure
         Covariance Structure Analysis: Maximum Likelihood Estimation

         Fit Function                                              0.0354
         Goodness of Fit Index (GFI)                               0.9774
         GFI Adjusted for Degrees of Freedom (AGFI)                0.8641
         Root Mean Square Residual (RMR)                           2.1241
         Parsimonious GFI (Mulaik, 1989)                           0.3258
         Chi-Square                                                3.9616 <-
         Chi-Square DF                                                  1
         Pr > Chi-Square                                           0.0465
         Independence Model Chi-Square                             67.227
         Independence Model Chi-Square DF                               3
         RMSEA Estimate                                            0.1626
         RMSEA 90% Lower Confidence Limit                          0.0168
         RMSEA 90% Upper Confidence Limit                          0.3435
         ECVI Estimate                                             0.1280
         ECVI 90% Lower Confidence Limit                                .
         ECVI 90% Upper Confidence Limit                           0.2218
         Probability of Close Fit                                  0.0779
         Bentler's Comparative Fit Index                           0.9539
         Normal Theory Reweighted LS Chi-Square                    3.8924
         Akaike's Information Criterion                            1.9616
         Bozdogan's (1987) CAIC                                   -1.7658
         Schwarz's Bayesian Criterion                             -0.7658
         McDonald's (1989) Centrality                              0.9870
         Bentler & Bonett's (1980) Non-normed Index                0.8617
         Bentler & Bonett's (1980) NFI                             0.9411
         James, Mulaik, & Brett (1982) Parsimonious NFI            0.3137
         Z-Test of Wilson & Hilferty (1931)                        1.7067
         Bollen (1986) Normed Index Rho1                           0.8232
         Bollen (1988) Non-normed Index Delta2                     0.9553
         Hoelter's (1983) Critical N                                  110
```

Just-Identified Model

```
Study of the Efficacy of Nosocomial Infection Control (SENIC)         22
       Path Analysis Example for 3 Observed Variables
              Just Identified (Saturated) Model

                     The CALIS Procedure
Covariance Structure Analysis: Maximum Likelihood Estimation

Fit Function                                           0.0000
Goodness of Fit Index (GFI)                            1.0000
GFI Adjusted for Degrees of Freedom (AGFI)                  .
Root Mean Square Residual (RMR)                        0.0000
Parsimonious GFI (Mulaik, 1989)                        0.0000
Chi-Square                                             0.0000
Chi-Square DF                                               0
Pr > Chi-Square                                        <.0001
Independence Model Chi-Square                          67.227
Independence Model Chi-Square DF                            3
RMSEA Estimate                                         0.0000
RMSEA 90% Lower Confidence Limit                            .
RMSEA 90% Upper Confidence Limit                            .
ECVI Estimate                                          0.1111
ECVI 90% Lower Confidence Limit                             .
ECVI 90% Upper Confidence Limit                             .
Probability of Close Fit                                    .
Bentler's Comparative Fit Index                        1.0000
Normal Theory Reweighted LS Chi-Square                 0.0000
Akaike's Information Criterion                         0.0000
Bozdogan's (1987) CAIC                                 0.0000
Schwarz's Bayesian Criterion                           0.0000
McDonald's (1989) Centrality                           1.0000
Bentler & Bonett's (1980) Non-normed Index                  .
Bentler & Bonett's (1980) NFI                          1.0000
James, Mulaik, & Brett (1982) Parsimonious NFI         0.0000
Z-Test of Wilson & Hilferty (1931)                          .
Bollen (1986) Normed Index Rho1                             .
Bollen (1988) Non-normed Index Delta2                  1.0000
Hoelter's (1983) Critical N                                 .
```

Path Analysis Example for 3 Observed Variables
Just Identified (Saturated) Model

The CALIS Procedure
Covariance Structure Analysis: Maximum Likelihood Estimation

Manifest Variable Equations with Estimates

```
infrisk =   0.3742*stay     +  1.0000 e1
Std Err     0.0561 gamma1
t Value     6.6744
xratio  =   5.0333*infrisk  +  1.9905*stay     +  1.0000 e2
Std Err     1.4130 beta        0.9912 gamma2
t Value     3.5622             2.0081
```

Variances of Exogenous Variables

Variable	Parameter	Estimate	Standard Error	t Value
stay	phi	3.65366	0.48824	7.48
e1	psi1	1.28638	0.17190	7.48
e2	psi2	287.64674	38.43841	7.48

The BMI Health Data

Two sets of measurements are taken on 500 subjects.

- Age
- Body Mass Index (BMI): Weight in kg / squared height in meters
- Percent body fat
- Serum Cholesterol
- Diastolic blood pressure

Measurement Set One is of higher quality. **Measurements in set one should be independent of measurements in set two.**

- Age1 is from birth certificates; Age2 is self-report
- BMI1 is based on height and weight measurements barefoot in a hospital gown in Clinic One. BMI2 is based on height and weight measurements in street clothes, in Clinic Two.
- Fat1 is estimated from immersion; Fat2 is based on tape and calipers
- Cholesterol measurements one and two are based on blood samples taken in Clinics One and Two respectively. They are sent to different labs – likely no difference in quality.
- On Clinic One, blood pressure is measured with an electronic cuff and a digital readout. Clinic Two uses an old-fashioned cuff with manual pump and analogue readout.

Question: Controlling for age and percent body fat, is BMI (still) related to cholesterol level and blood pressure?

```
/********************* bmi3.sas *************************/
options linesize=79 pagesize = 500 noovp formdlim='-';
title 'BMI and Health: Like bmi2.sas, but try to make it shorter';

data health;
     infile 'bmihealth.data';
     input age1 bmi1 fat1 cholest1 diastol1
           age2 bmi2 fat2 cholest2 diastol2;
           /* fat1 and fat2 are percent body fat */
     age = (age1+age2)/2; bmi = (bmi1+bmi2)/2; fat = (fat1+fat2)/2;
     cholest = (cholest1+cholest2)/2 ; diastol = (diastol1+diastol2)/2;

proc calis cov vardef=n;
   /* Analyze the covariance matrix (Default is corr). Divide by n to
      get true MLE of covariance matrix. */
     title2 'Full Model';
     var age1 -- diastol2; /* Name the observed variables */
     /* Now give simultaneous equations, separated by commas. Latent
        variables begin with F for factor. Error terms begin with
        E for error or D for disturbance. SAS is not case sensitive.
        You must name all the parameters. Optional starting values in
        parentheses may be given after the parameters. */
     lineqs
          Fcholest = gamma11 Fage + gamma12 Fbmi + gamma13 Ffat + e1,
          Fdiastol = gamma21 Fage + gamma22 Fbmi + gamma23 Ffat + e2,
          age1     = Fage + delta11,
          bmi1     = Fbmi + delta12,
          fat1     = Ffat + delta13,
          age2     = Fage + delta21,
          bmi2     = Fbmi + delta22,
          fat2     = Ffat + delta23,
          cholest1 = Fcholest + eps11,
          diastol1 = Fdiastol + eps12,
          cholest2 = Fcholest + eps21,
          diastol2 = Fdiastol + eps22;
     std   /* Variances (not standard deviations) will be
              called V-something. Colon means fill in the numbers. */
          Fage Fbmi Ffat e1 e2
          delta11 delta12 delta13 delta21 delta22 delta23
          eps11 eps12 eps21 eps22 = v: ;
     cov   /* Covariances: If not mentioned, it's zero.  */
          Fage Ffat Fbmi = phi: , e1 e2 = psi: ,
          delta11 delta12 delta13 eps11 eps12 = TED1_: ,
          delta21 delta22 delta23 eps21 eps22 = TED2_: ;
     bounds 0.0 < v1-v15;  /* Variances are positive */

/* Note: These std and cov statements will generate warnings saying
         "Shorter parameter list than variable list ..." These can be
          ignored. There would be no warnings if we specified the
          number of parameters, as in    15 * v:  and
          delta11 delta12 delta13 eps11 eps12 = 10 * TED1_:   etc.
          But it's more convenient not to have to count parameters. */

/*  Now fit a reduced model to test H0: gamma12 = gamma22 = 0,
    meaning BMI is unrelated to either cholesterol or blood pressure
    if we allow for age and percent body fat.  Use psummary to see
    just the minimal output needed for a likelihood ratio test. */
```

```
proc calis cov vardef=n psummary;
     title2 'Reduced Model for testing BMI on both DVs at once';
     var age1 -- diastol2;
     lineqs
          Fcholest = gamma11 Fage + gamma12 Fbmi + gamma13 Ffat + e1,
          Fdiastol = gamma21 Fage + gamma22 Fbmi + gamma23 Ffat + e2,
          age1     = Fage + delta11,
          bmi1     = Fbmi + delta12,
          fat1     = Ffat + delta13,
          age2     = Fage + delta21,
          bmi2     = Fbmi + delta22,
          fat2     = Ffat + delta23,
          cholest1 = Fcholest + eps11,
          diastol1 = Fdiastol + eps12,
          cholest2 = Fcholest + eps21,
          diastol2 = Fdiastol + eps22;
     std
          Fage Fbmi Ffat e1 e2
          delta11 delta12 delta13 delta21 delta22 delta23
          eps11 eps12 eps21 eps22 = v: ;
     cov
          Fage Ffat Fbmi = phi: , e1 e2 = psi: ,
          delta11 delta12 delta13 eps11 eps12 = TED1_: ,
          delta21 delta22 delta23 eps21 eps22 = TED2_: ;
     bounds 0.0 < v1-v15;
     lincon gamma12=0, gamma22=0; /* Constrain model to obey this H0 */
     /* Much safer than fitting a model with the variables just missing
        in the regression equations. However, SAS will warn us that
        "There are 2 active constraints at the solution," and carry on
        in a pretty menacing way. The warning can be ignored, in this
        particular case where the linear constraints are setting
        parameters exactly equal to zero. Do NOT ignore the warning
        if an inequality is involved.   */

proc iml;
     title2 'Calculate Likelihood ratio test of H0: gamma12=gamma22=0';
     G = 19.5309 - 18.9011;
     /* Difference between chisquares (copied from the printout) */
     pval = 1 - probchi(G,2);
     print G,pval;
     print "  ";

/* In practice, you'd do this with a calculator */
```

```
--------------------------------------------------------------------------------

          BMI and Health: Like bmi2.sas, but try to make it shorter          1
                                  Full Model

                              The CALIS Procedure
          Covariance Structure Analysis: Pattern and Initial Values

                            LINEQS Model Statement


                       Matrix      Rows    Columns    ------Matrix Type-------

Term 1            1    _SEL_         10         27    SELECTION
                  2    _BETA_        27         27    EQSBETA        IMINUSINV
                  3    _GAMMA_       27         15    EQSGAMMA
                  4    _PHI_         15         15    SYMMETRIC


                         The 12 Endogenous Variables

    Manifest        age1      bmi1      fat1      cholest1  diastol1  age2
                    bmi2      fat2      cholest2  diastol2
    Latent          Fcholest  Fdiastol


                          The 15 Exogenous Variables

    Manifest
    Latent          Fage      Fbmi      Ffat
    Error           e1        e2        eps11     eps12     eps21
                    eps22     delta11   delta12   delta13   delta21
                    delta22   delta23
--------------------------------------------------------------------------------

          BMI and Health: Like bmi2.sas, but try to make it shorter          2
                                  Full Model

                              The CALIS Procedure
          Covariance Structure Analysis: Pattern and Initial Values

             Manifest Variable Equations with Initial Estimates


               age1     =   1.0000 Fage     +  1.0000 delta11
               bmi1     =   1.0000 Fbmi     +  1.0000 delta12
               fat1     =   1.0000 Ffat     +  1.0000 delta13
               cholest1 =   1.0000 Fcholest +  1.0000 eps11
               diastol1 =   1.0000 Fdiastol +  1.0000 eps12
               age2     =   1.0000 Fage     +  1.0000 delta21
               bmi2     =   1.0000 Fbmi     +  1.0000 delta22
               fat2     =   1.0000 Ffat     +  1.0000 delta23
               cholest2 =   1.0000 Fcholest +  1.0000 eps21
               diastol2 =   1.0000 Fdiastol +  1.0000 eps22

--------------------------------------------------------------------------------
```

The CALIS Procedure
Covariance Structure Analysis: Pattern and Initial Values

Latent Variable Equations with Initial Estimates

```
Fcholest =        .*Fage     +       .*Fbmi     +       .*Ffat
                   gamma11            gamma12            gamma13

                      +  1.0000 e1


Fdiastol =        .*Fage     +       .*Fbmi     +       .*Ffat
                   gamma21            gamma22            gamma23

                      +  1.0000 e2
```

Variances of Exogenous Variables

Variable	Parameter	Estimate
Fage	v1	.
Fbmi	v2	.
Ffat	v3	.
e1	v4	.
e2	v5	.
eps11	v12	.
eps12	v13	.
eps21	v14	.
eps22	v15	.
delta11	v6	.
delta12	v7	.
delta13	v8	.
delta21	v9	.
delta22	v10	.
delta23	v11	.

Covariances Among Exogenous Variables

Var1	Var2	Parameter	Estimate
Fage	Fbmi	phi2	.
Fage	Ffat	phi1	.
Fbmi	Ffat	phi3	.
e1	e2	psi1	.
eps11	eps12	TED1_10	.
eps21	eps22	TED2_10	.
eps11	delta11	TED1_4	.
eps12	delta11	TED1_7	.
eps11	delta12	TED1_5	.
eps12	delta12	TED1_8	.

```
               delta11  delta12  TED1_1                .
               eps11    delta13  TED1_6                .
               eps12    delta13  TED1_9                .
               delta11  delta13  TED1_2                .
               delta12  delta13  TED1_3                .
               eps21    delta21  TED2_4                .
               eps22    delta21  TED2_7                .
               eps21    delta22  TED2_5                .
               eps22    delta22  TED2_8                .
               delta21  delta22  TED2_1                .
               eps21    delta23  TED2_6                .
               eps22    delta23  TED2_9                .
               delta21  delta23  TED2_2                .
               delta22  delta23  TED2_3                .
```

```
           BMI and Health: Like bmi2.sas, but try to make it shorter          4
                                  Full Model

                              The CALIS Procedure
         Covariance Structure Analysis: Maximum Likelihood Estimation

            Observations         500    Model Terms              1
            Variables             10    Model Matrices           4
            Informations          55    Parameters              45


                 Variable          Mean       Std Dev

                 age1          43.08800      12.99955
                 bmi1          25.43580       4.54927
                 fat1          18.79000       7.75224
                 cholest1     262.02740      52.50262
                 diastol1      88.42400      19.27206
                 age2          44.40600      12.41762
                 bmi2          25.51760       3.72546
                 fat2          18.90280       7.56396
                 cholest2     261.24560      53.87560
                 diastol2      88.70000      13.08610

NOTE: Some initial estimates computed by two-stage LS method.
```

The CALIS Procedure
Covariance Structure Analysis: Maximum Likelihood Estimation

Vector of Initial Estimates

	Parameter	Estimate	Type
1	gamma11	-0.04470	Matrix Entry: _GAMMA_[11:1]
2	gamma12	-6.33575	Matrix Entry: _GAMMA_[11:2]
3	gamma13	4.81865	Matrix Entry: _GAMMA_[11:3]
4	gamma21	0.04906	Matrix Entry: _GAMMA_[12:1]
5	gamma22	-0.29770	Matrix Entry: _GAMMA_[12:2]
6	gamma23	1.43699	Matrix Entry: _GAMMA_[12:3]
7	v1	147.24427	Matrix Entry: _PHI_[1:1]
8	phi2	8.79461	Matrix Entry: _PHI_[2:1]
9	v2	12.33537	Matrix Entry: _PHI_[2:2]
10	phi1	27.68039	Matrix Entry: _PHI_[3:1]
11	phi3	22.57943	Matrix Entry: _PHI_[3:2]
12	v3	45.86815	Matrix Entry: _PHI_[3:3]
13	v4	2389	Matrix Entry: _PHI_[4:4]
14	psi1	71.22487	Matrix Entry: _PHI_[5:4]
15	v5	75.27225	Matrix Entry: _PHI_[5:5]
16	v12	192.26932	Matrix Entry: _PHI_[6:6]
17	TED1_10	39.74295	Matrix Entry: _PHI_[7:6]
18	v13	215.64902	Matrix Entry: _PHI_[7:7]
19	v14	338.32405	Matrix Entry: _PHI_[8:8]
20	TED2_10	-38.53896	Matrix Entry: _PHI_[9:8]
21	v15	15.48280	Matrix Entry: _PHI_[9:9]
22	TED1_4	-0.37855	Matrix Entry: _PHI_[10:6]
23	TED1_7	10.18200	Matrix Entry: _PHI_[10:7]
24	v6	21.74398	Matrix Entry: _PHI_[10:10]
25	TED1_5	-3.46658	Matrix Entry: _PHI_[11:6]
26	TED1_8	6.35643	Matrix Entry: _PHI_[11:7]
27	TED1_1	1.33004	Matrix Entry: _PHI_[11:10]
28	v7	8.36053	Matrix Entry: _PHI_[11:11]
29	TED1_6	0.15593	Matrix Entry: _PHI_[12:6]
30	TED1_9	3.93632	Matrix Entry: _PHI_[12:7]
31	TED1_2	-1.58351	Matrix Entry: _PHI_[12:10]
32	TED1_3	5.78119	Matrix Entry: _PHI_[12:11]
33	v8	14.22915	Matrix Entry: _PHI_[12:12]
34	TED2_4	1.94395	Matrix Entry: _PHI_[13:8]
35	TED2_7	-6.39489	Matrix Entry: _PHI_[13:9]
36	v9	6.95289	Matrix Entry: _PHI_[13:13]
37	TED2_5	2.83802	Matrix Entry: _PHI_[14:8]
38	TED2_8	-0.80271	Matrix Entry: _PHI_[14:9]
39	TED2_1	0.02965	Matrix Entry: _PHI_[14:13]
40	v10	1.54368	Matrix Entry: _PHI_[14:14]
41	TED2_6	-2.68759	Matrix Entry: _PHI_[15:8]
42	TED2_9	-1.99128	Matrix Entry: _PHI_[15:9]
43	TED2_2	2.03567	Matrix Entry: _PHI_[15:13]
44	TED2_3	-1.64710	Matrix Entry: _PHI_[15:14]
45	v11	11.34540	Matrix Entry: _PHI_[15:15]

Full Model

The CALIS Procedure

Covariance Structure Analysis: Maximum Likelihood Estimation

Dual Quasi-Newton Optimization

Dual Broyden - Fletcher - Goldfarb - Shanno Update (DBFGS)

```
Parameter Estimates                 45
Functions (Observations)            55
Lower Bounds                        15
Upper Bounds                         0
```

Optimization Start

```
Active Constraints                   0  Objective Function       0.3271903962
Max Abs Gradient Element  0.0798909029
```

Iter	Restarts	Func Calls	Act Con	Objective Function	Obj Fun Change	Max Abs Gradient Element	Step Size	Slope Search Direc
1	0	3	0	0.30488	0.0223	0.2450	0.0467	-1.031
2	0	4	0	0.28493	0.0200	0.1155	0.321	-0.174
3	0	5	0	0.26868	0.0163	0.0924	1.000	-0.0414
4	0	7	0	0.21790	0.0508	0.2954	2.854	-0.0371
5	0	8	0	0.19763	0.0203	0.1178	1.000	-0.0295
6	0	10	0	0.18967	0.00796	0.0603	1.110	-0.0139
7	0	12	0	0.18633	0.00334	0.0332	1.482	-0.0039
8	0	13	0	0.18070	0.00563	0.0151	1.517	-0.0055
9	0	14	0	0.17263	0.00807	0.0619	1.804	-0.0078
10	0	15	0	0.16947	0.00316	0.1056	4.513	-0.0045
11	0	17	0	0.16253	0.00694	0.0414	1.894	-0.0083
12	0	18	0	0.15246	0.0101	0.0683	3.981	-0.0044
13	0	20	0	0.14649	0.00597	0.0202	1.567	-0.0072
14	0	21	0	0.14215	0.00433	0.1391	5.726	-0.0026
15	0	23	0	0.12979	0.0124	0.0571	3.143	-0.0079
16	0	24	0	0.12038	0.00941	0.0181	3.313	-0.0093
17	0	26	0	0.11799	0.00239	0.00639	1.187	-0.0043
18	0	27	0	0.11522	0.00277	0.0316	7.956	-0.0008
19	0	29	0	0.10842	0.00680	0.0207	3.239	-0.0043
20	0	31	0	0.10677	0.00165	0.00901	1.866	-0.0017
21	0	32	0	0.10409	0.00269	0.0117	3.764	-0.0011
22	0	33	0	0.10265	0.00143	0.0249	3.013	-0.0022
23	0	34	0	0.10065	0.00201	0.00890	1.394	-0.0026
24	0	35	0	0.09993	0.000716	0.0147	5.008	-0.0010
25	0	36	0	0.09890	0.00103	0.00332	0.942	-0.0019
26	0	38	0	0.09831	0.000588	0.00738	4.447	-0.0003
27	0	40	0	0.09319	0.00512	0.00248	12.702	-0.0008
28	0	42	0	0.09298	0.000213	0.00225	1.906	-0.0002
29	0	44	0	0.09178	0.00120	0.00948	13.803	-0.0002
30	0	46	0	0.09106	0.000712	0.00457	1.611	-0.0009
31	0	47	0	0.09020	0.000866	0.0143	6.590	-0.0003

32	0	49	0	0.08621	0.00399	0.0242	7.518	-0.0011
33	0	51	0	0.08430	0.00191	0.00500	1.728	-0.0022
34	0	53	0	0.08346	0.000838	0.00798	5.288	-0.0003
35	0	55	0	0.08128	0.00218	0.00609	4.202	-0.0010
36	0	57	0	0.08104	0.000241	0.00472	1.854	-0.0003
37	0	59	0	0.07767	0.00338	0.00922	30.705	-0.0002
38	0	61	0	0.07639	0.00127	0.00196	1.390	-0.0019
39	0	62	0	0.07594	0.000455	0.00499	8.567	-0.0004
40	0	63	0	0.07521	0.000729	0.00342	0.835	-0.0014
41	0	65	0	0.07485	0.000356	0.00379	2.284	-0.0003
42	0	67	0	0.07157	0.00329	0.00428	18.249	-0.0004
43	0	69	0	0.07101	0.000553	0.00228	1.309	-0.0008
44	0	71	0	0.07080	0.000212	0.00318	3.657	-0.0001
45	0	73	0	0.06998	0.000819	0.00277	7.534	-0.0002
46	0	75	0	0.06606	0.00392	0.00986	9.447	-0.0008
47	0	77	0	0.06532	0.000736	0.00178	1.408	-0.0011
48	0	78	0	0.06525	0.000071	0.00753	10.000	-561E-7
49	0	80	0	0.06480	0.000451	0.00153	2.125	-0.0004
50	0	82	0	0.06214	0.00266	0.00382	11.922	-0.0004
51	0	84	0	0.06208	0.000057	0.00186	1.548	-0.0001
52	0	86	0	0.06168	0.000402	0.00353	23.010	-351E-7
53	0	87	0	0.06108	0.000600	0.00145	1.794	-0.0006
54	0	88	0	0.06054	0.000545	0.00347	4.024	-0.0004
55	0	90	0	0.06021	0.000326	0.000905	1.538	-0.0004
56	0	92	0	0.06017	0.000043	0.00122	1.903	-446E-7
57	0	95	0	0.05838	0.00179	0.0188	118.9	-299E-7
58	0	97	0	0.05783	0.000550	0.00233	1.015	-0.0011
59	0	99	0	0.05775	0.000078	0.00690	3.725	-419E-7
60	0	101	0	0.05745	0.000301	0.00141	6.628	-0.0001
61	0	103	0	0.05742	0.000031	0.00115	1.668	-372E-7
62	0	105	0	0.05688	0.000540	0.00205	32.205	-242E-7
63	0	107	0	0.05658	0.000301	0.00236	1.793	-0.0003
64	0	108	0	0.05610	0.000477	0.00178	4.389	-0.0002
65	0	110	0	0.05598	0.000123	0.000626	1.256	-0.0002
66	0	112	0	0.05597	0.000013	0.000690	2.443	-11E-6
67	0	115	0	0.05517	0.000799	0.00409	131.7	-122E-7
68	0	117	0	0.05479	0.000379	0.000484	1.120	-0.0007
69	0	118	0	0.05466	0.000128	0.00549	10.000	-275E-7
70	0	119	0	0.05445	0.000213	0.00151	2.161	-0.0001
71	0	121	0	0.05441	0.000042	0.000696	1.143	-0.0001
72	0	123	0	0.05372	0.000688	0.00791	93.507	-112E-7
73	0	125	0	0.05344	0.000282	0.000566	1.288	-0.0004
74	0	126	0	0.05303	0.000404	0.00897	9.689	-0.0001
75	0	127	0	0.05243	0.000602	0.00367	2.308	-0.0004
76	0	129	0	0.05239	0.000038	0.000588	1.084	-0.0001
77	0	131	0	0.05225	0.000141	0.00659	39.678	-711E-8
78	0	132	0	0.05205	0.000196	0.000990	1.511	-0.0002
79	0	134	0	0.05164	0.000415	0.00933	10.898	-0.0001
80	0	135	0	0.05104	0.000602	0.000626	2.058	-0.0005
81	0	137	0	0.05098	0.000057	0.000809	1.207	-0.0001
82	0	139	0	0.05088	0.000105	0.00478	22.067	-955E-8
83	0	141	0	0.05060	0.000280	0.00387	2.962	-0.0002
84	0	143	0	0.04877	0.00183	0.00849	16.371	-0.0002
85	0	145	0	0.04859	0.000182	0.000871	1.000	-0.0003
86	0	147	0	0.04857	0.000020	0.00138	2.740	-142E-7
87	0	149	0	0.04836	0.000211	0.00177	18.600	-228E-7
88	0	151	0	0.04788	0.000478	0.00199	3.899	-0.0003
89	0	152	0	0.04718	0.000695	0.00214	3.152	-0.0004

90	0	154	0	0.04700	0.000187	0.000968	1.356	-0.0003
91	0	156	0	0.04699	8.492E-6	0.000540	1.554	-11E-6
92	0	158	0	0.04690	0.000093	0.00477	37.095	-504E-8
93	0	159	0	0.04676	0.000138	0.000871	1.325	-0.0002
94	0	160	0	0.04655	0.000212	0.00489	4.160	-0.0001
95	0	162	0	0.04584	0.000702	0.0101	4.453	-0.0003
96	0	164	0	0.04564	0.000205	0.000397	1.388	-0.0003
97	0	166	0	0.04563	8.358E-6	0.00138	4.463	-374E-8
98	0	169	0	0.04487	0.000759	0.00545	120.1	-125E-7
99	0	170	0	0.04428	0.000588	0.00236	1.775	-0.0011
100	0	172	0	0.04406	0.000219	0.00152	1.413	-0.0003
101	0	174	0	0.04146	0.00260	0.00156	40.057	-0.0001
102	0	176	0	0.04120	0.000264	0.000451	1.223	-0.0005
103	0	178	0	0.04118	0.000019	0.000447	1.555	-244E-7
104	0	179	0	0.04116	0.000022	0.000471	4.846	-1E-5
105	0	180	0	0.04115	7.352E-6	0.000827	10.000	-516E-8
106	0	182	0	0.04110	0.000050	0.000442	2.496	-397E-7
107	0	184	0	0.04060	0.000503	0.000337	17.977	-56E-6
108	0	186	0	0.04059	3.087E-6	0.000336	1.875	-331E-8
109	0	189	0	0.04053	0.000063	0.00707	53.631	-288E-8
110	0	190	0	0.04043	0.000101	0.000692	1.032	-0.0002
111	0	192	0	0.04037	0.000065	0.00481	2.573	-504E-7
112	0	194	0	0.03978	0.000589	0.00136	15.885	-0.0001
113	0	196	0	0.03977	9.458E-6	0.000233	1.236	-15E-6
114	0	198	0	0.03977	2.135E-6	0.000208	2.540	-168E-8
115	0	200	0	0.03976	0.000010	0.00184	14.836	-138E-8
116	0	202	0	0.03969	0.000067	0.00244	7.981	-167E-7
117	0	204	0	0.03932	0.000364	0.00278	9.270	-0.0001
118	0	206	0	0.03930	0.000024	0.000241	1.080	-431E-7
119	0	208	0	0.03930	1.155E-6	0.000348	3.301	-699E-9
120	0	211	0	0.03925	0.000045	0.00231	60.150	-15E-7
121	0	212	0	0.03920	0.000055	0.000872	1.652	-0.0001
122	0	213	0	0.03912	0.000080	0.00202	6.629	-207E-7
123	0	215	0	0.03872	0.000397	0.00527	7.591	-0.0001
124	0	217	0	0.03848	0.000242	0.000372	1.713	-0.0003
125	0	219	0	0.03848	9.245E-7	0.000173	1.249	-148E-8
126	0	221	0	0.03847	4.1E-6	0.000819	29.763	-275E-9
127	0	222	0	0.03847	7.103E-6	0.000170	1.335	-768E-8
128	0	223	0	0.03846	0.000011	0.000957	2.218	-801E-8
129	0	225	0	0.03839	0.000067	0.00353	7.403	-18E-6
130	0	227	0	0.03820	0.000186	0.000112	4.218	-0.0001
131	0	229	0	0.03820	1.855E-7	0.000087	1.292	-287E-9
132	0	232	0	0.03820	5.998E-6	0.000294	135.1	-89E-9
133	0	233	0	0.03819	5.358E-6	0.000228	1.477	-102E-7
134	0	235	0	0.03819	1.487E-6	0.000107	1.738	-171E-8
135	0	238	0	0.03816	0.000030	0.000201	59.983	-124E-8
136	0	240	0	0.03816	8.023E-7	0.000110	1.409	-114E-8
137	0	241	0	0.03816	5.68E-7	0.000226	5.289	-379E-9
138	0	243	0	0.03816	1.847E-7	0.000044	1.111	-332E-9
139	0	245	0	0.03816	1.663E-6	0.000771	99.827	-33E-9
140	0	246	0	0.03815	1.98E-6	0.000111	1.417	-293E-8
141	0	248	0	0.03815	6.908E-6	0.00140	34.225	-404E-9
142	0	249	0	0.03814	0.000011	0.000057	1.353	-128E-7
143	0	250	0	0.03812	0.000016	0.00187	3.386	-811E-8
144	0	252	0	0.03804	0.000080	0.00331	6.504	-246E-7
145	0	254	0	0.03801	0.000030	0.000073	1.453	-415E-7
146	0	255	0	0.03801	3.05E-7	0.000193	10.000	-75E-9
147	0	258	0	0.03800	6.288E-6	0.000235	26.399	-578E-9

148	0	260	0	0.03799	0.000015	0.000379	2.256	-139E-7
149	0	262	0	0.03794	0.000049	0.000593	11.529	-858E-8
150	0	264	0	0.03794	2.908E-6	0.000025	1.061	-547E-8
151	0	266	0	0.03794	2.06E-8	0.000026	2.650	-16E-9
152	0	269	0	0.03793	2.505E-6	0.000404	236.0	-21E-9
153	0	270	0	0.03793	2.36E-6	0.000083	1.350	-464E-8
154	0	272	0	0.03793	4.186E-7	0.000027	1.627	-515E-9
155	0	275	0	0.03790	0.000033	0.000290	204.2	-321E-9
156	0	277	0	0.03790	1.092E-6	0.000034	1.043	-209E-8
157	0	279	0	0.03790	5.96E-8	0.000047	5.330	-22E-9
158	0	282	0	0.03790	1.431E-6	0.000091	30.881	-96E-9
159	0	284	0	0.03790	2.441E-7	0.000113	2.504	-195E-9
160	0	286	0	0.03789	3.525E-6	0.000538	22.313	-273E-9
161	0	287	0	0.03789	4.357E-6	0.00148	4.511	-195E-8
162	0	288	0	0.03788	7.036E-6	0.000063	2.561	-425E-8
163	0	290	0	0.03788	2.27E-6	0.000435	1.460	-31E-7
164	0	292	0	0.03788	4.058E-7	9.035E-6	1.559	-52E-8

Optimization Results

Iterations	164	Function Calls	293
Gradient Calls	232	Active Constraints	0
Objective Function	0.0378779129	Max Abs Gradient Element	9.0354545E-6
Slope of Search Direction	-5.202293E-7		

ABSGCONV convergence criterion satisfied.

Full Model

The CALIS Procedure

Covariance Structure Analysis: Maximum Likelihood Estimation

Fit Function	0.0379
Goodness of Fit Index (GFI)	0.9926
GFI Adjusted for Degrees of Freedom (AGFI)	0.9591
Root Mean Square Residual (RMR)	19.4718
Parsimonious GFI (Mulaik, 1989)	0.2206
Chi-Square	18.9011
Chi-Square DF	10
Pr > Chi-Square	0.0415
Independence Model Chi-Square	4015.9
Independence Model Chi-Square DF	45
RMSEA Estimate	0.0422
RMSEA 90% Lower Confidence Limit	0.0081
RMSEA 90% Upper Confidence Limit	0.0711
ECVI Estimate	0.2223
ECVI 90% Lower Confidence Limit	0.2051
ECVI 90% Upper Confidence Limit	0.2554
Probability of Close Fit	0.6316
Bentler's Comparative Fit Index	0.9978
Normal Theory Reweighted LS Chi-Square	18.6927
Akaike's Information Criterion	-1.0989
Bozdogan's (1987) CAIC	-53.2450
Schwarz's Bayesian Criterion	-43.2450
McDonald's (1989) Centrality	0.9911

```
Bentler & Bonett's (1980) Non-normed Index           0.9899
Bentler & Bonett's (1980) NFI                        0.9953
James, Mulaik, & Brett (1982) Parsimonious NFI       0.2212
Z-Test of Wilson & Hilferty (1931)                   1.7350
Bollen (1986) Normed Index Rho1                      0.9788
Bollen (1988) Non-normed Index Delta2                0.9978
Hoelter's (1983) Critical N                             485
```

```
                  The CALIS Procedure
Covariance Structure Analysis: Maximum Likelihood Estimation

         Manifest Variable Equations with Estimates


       age1     =   1.0000 Fage     +  1.0000 delta11
       bmi1     =   1.0000 Fbmi     +  1.0000 delta12
       fat1     =   1.0000 Ffat     +  1.0000 delta13
       cholest1 =   1.0000 Fcholest +  1.0000 eps11
       diastol1 =   1.0000 Fdiastol +  1.0000 eps12
       age2     =   1.0000 Fage     +  1.0000 delta21
       bmi2     =   1.0000 Fbmi     +  1.0000 delta22
       fat2     =   1.0000 Ffat     +  1.0000 delta23
       cholest2 =   1.0000 Fcholest +  1.0000 eps21
       diastol2 =   1.0000 Fdiastol +  1.0000 eps22
```

The CALIS Procedure
Covariance Structure Analysis: Maximum Likelihood Estimation

Latent Variable Equations with Estimates

```
Fcholest =   0.1480*Fage     + -1.2703*Fbmi     +  2.2271*Ffat
Std Err      0.2128 gamma11     1.6550 gamma12     0.8974 gamma13
t Value      0.6957            -0.7675             2.4818

                       +  1.0000 e1



Fdiastol =   0.0104*Fage     + -0.1054*Fbmi     +  1.2692*Ffat
Std Err      0.0458 gamma21     0.3941 gamma22     0.2044 gamma23
t Value      0.2268            -0.2675             6.2090

                       +  1.0000 e2
```

Variances of Exogenous Variables

Variable	Parameter	Estimate	Standard Error	t Value
Fage	v1	148.12838	9.79411	15.12
Fbmi	v2	12.54181	0.94050	13.34
Ffat	v3	46.99750	3.28849	14.29
e1	v4	2391	161.53168	14.81
e2	v5	75.69775	8.78257	8.62
eps11	v12	195.80618	54.03321	3.62
eps12	v13	207.71308	15.24803	13.62
eps21	v14	336.03140	56.74542	5.92
eps22	v15	25.20654	7.67288	3.29
delta11	v6	22.30517	3.22022	6.93
delta12	v7	8.61051	0.71704	12.01
delta13	v8	13.95514	1.71930	8.12
delta21	v9	6.30433	2.90105	2.17
delta22	v10	1.28485	0.48547	2.65
delta23	v11	11.46363	1.67508	6.84

Covariances Among Exogenous Variables

Var1	Var2	Parameter	Estimate	Standard Error	t Value
Fage	Fbmi	phi2	8.53524	2.14246	3.98
Fage	Ffat	phi1	28.67293	4.20356	6.82
Fbmi	Ffat	phi3	21.07021	1.58695	13.28
e1	e2	psi1	26.99445	23.13516	1.17
eps11	eps12	TED1_10	2.37369	17.44389	0.14
eps21	eps22	TED2_10	10.55839	12.14484	0.87
eps11	delta11	TED1_4	1.46571	9.28626	0.16
eps12	delta11	TED1_7	5.50639	4.26027	1.29
eps11	delta12	TED1_5	-1.68780	4.05537	-0.42
eps12	delta12	TED1_8	8.22814	2.38542	3.45
delta11	delta12	TED1_1	2.41139	1.00109	2.41
eps11	delta13	TED1_6	-1.67949	6.62998	-0.25
eps12	delta13	TED1_9	0.90570	3.57876	0.25
delta11	delta13	TED1_2	-1.23726	1.62183	-0.76
delta12	delta13	TED1_3	8.07727	0.96844	8.34
eps21	delta21	TED2_4	0.83261	9.02367	0.09
eps22	delta21	TED2_7	2.24903	2.78751	0.81
eps21	delta22	TED2_5	0.09756	3.34404	0.03
eps22	delta22	TED2_8	2.97256	1.44467	2.06
delta21	delta22	TED2_1	0.26655	0.76726	0.35
eps21	delta23	TED2_6	-4.03672	6.65942	-0.61
eps22	delta23	TED2_9	2.33466	2.56252	0.91
delta21	delta23	TED2_2	1.97235	1.51921	1.30
delta22	delta23	TED2_3	0.06895	0.74323	0.09

Manifest Variable Equations with Standardized Estimates

Skipping the standardized estimates ...

The CALIS Procedure
Covariance Structure Analysis: Maximum Likelihood Estimation

WARNING: There are 2 active constraints at the solution. The standard errors and Chi-Square test statistic assume the solution is located in the interior of the parameter space and hence do not apply if it is likely that some different set of inequality constraints could be active.

NOTE: The degrees of freedom are increased by the number of active constraints (see Dijkstra, 1992). The number of parameters in calculating fit indices is decreased by the number of active constraints. To turn off the adjustment, use the NOADJDF option.

Reduced Model for testing BMI on both DVs at once

The CALIS Procedure
Covariance Structure Analysis: Maximum Likelihood Estimation

Fit Function	0.0391
Goodness of Fit Index (GFI)	0.9924
GFI Adjusted for Degrees of Freedom (AGFI)	0.9650
Root Mean Square Residual (RMR)	19.7718
Parsimonious GFI (Mulaik, 1989)	0.2646
Chi-Square	19.5309
Chi-Square DF	12
Pr > Chi-Square	0.0765
Independence Model Chi-Square	4015.9
Independence Model Chi-Square DF	45
RMSEA Estimate	0.0355
RMSEA 90% Lower Confidence Limit	.
RMSEA 90% Upper Confidence Limit	0.0630
ECVI Estimate	0.2154
ECVI 90% Lower Confidence Limit	.
ECVI 90% Upper Confidence Limit	0.2482
Probability of Close Fit	0.7834
Bentler's Comparative Fit Index	0.9981
Normal Theory Reweighted LS Chi-Square	19.2565
Akaike's Information Criterion	-4.4691
Bozdogan's (1987) CAIC	-67.0444
Schwarz's Bayesian Criterion	-55.0444
McDonald's (1989) Centrality	0.9925
Bentler & Bonett's (1980) Non-normed Index	0.9929
Bentler & Bonett's (1980) NFI	0.9951
James, Mulaik, & Brett (1982) Parsimonious NFI	0.2654
Z-Test of Wilson & Hilferty (1931)	1.4315
Bollen (1986) Normed Index Rho1	0.9818
Bollen (1988) Non-normed Index Delta2	0.9981
Hoelter's (1983) Critical N	539

Calculate Likelihood ratio test of H0: gamma12=gamma22=0

G

0.6298

PVAL

0.7298619