# Measurement Error Regression on BMI Data

```
/********************** bmi2.sas *************************/
options linesize=79 pagesize = 500 noovp formdlim='_' nodate;
title 'BMI and Health: Use the Double Measurement Design';

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) */
          Fage = phi11, Fbmi = phi22, Ffat = phi33,
          e1 = psi11, e2 = psi22,
          delta11 = TD1_11, delta12 = TD1_22, delta13 = TD1_33,
          delta21 = TD2_11, delta22 = TD2_22, delta23 = TD2_33,
          eps11   = TE1_11, eps12   = TE1_22,
          eps21   = TE2_11, eps22   = TE2_22;
     cov                    /* Covariances */
          Fage Fbmi = phi12, Fage Ffat = phi13, Fbmi Ffat = phi23,
          e1 e2 = psi12,
          delta11 delta12 = TD1_12, delta11 delta13 = TD1_13,
          delta12 delta13 = TD1_23,
          delta21 delta22 = TD2_12, delta21 delta23 = TD2_13,
          delta22 delta23 = TD2_23,
          eps11 eps12 = TE1_12,
          eps21 eps22 = TE2_12,
          delta11 eps11 = TDE1_11, delta11 eps12 = TDE1_12,
          delta12 eps11 = TDE1_21, delta12 eps12 = TDE1_22,
          delta13 eps11 = TDE1_31, delta13 eps12 = TDE1_32,
```

```
          delta21 eps21 = TDE2_11, delta21 eps22 = TDE2_12,
          delta22 eps21 = TDE2_21, delta22 eps22 = TDE2_22,
          delta23 eps21 = TDE2_31, delta23 eps22 = TDE2_32;
     bounds                  /* Variances are positive */
          0.0 < phi11,   0.0 < phi22,   0.0 < phi33,
          0.0 < psi11,   0.0 < psi22,
          0.0 < TD1_11,  0.0 < TD1_22,  0.0 < TD1_33,
          0.0 < TD2_11,  0.0 < TD2_22,  0.0 < TD2_33,
          0.0 < TE1_11,  0.0 < TE1_22,
          0.0 < TE2_11,  0.0 < TE2_22;

/*  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.  Cut out some long comments.*/

proc calis cov vardef=n;
/* Analyze the covariance matrix (Default is corr). Divide by n to
      get true MLE of covariance matrix. */
title2 'Reduced Model for testing BMI on both DVs';
     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) */
          Fage = phi11, Fbmi = phi22, Ffat = phi33,
          e1 = psi11, e2 = psi22,
          delta11 = TD1_11, delta12 = TD1_22, delta13 = TD1_33,
          delta21 = TD2_11, delta22 = TD2_22, delta23 = TD2_33,
          eps11   = TE1_11, eps12   = TE1_22,
          eps21   = TE2_11, eps22   = TE2_22;
     cov                     /* Covariances */
          Fage Fbmi = phi12, Fage Ffat = phi13, Fbmi Ffat = phi23,
          e1 e2 = psi12,
          delta11 delta12 = TD1_12, delta11 delta13 = TD1_13,
          delta12 delta13 = TD1_23,
          delta21 delta22 = TD2_12, delta21 delta23 = TD2_13,
          delta22 delta23 = TD2_23,
          eps11 eps12 = TE1_12,
          eps21 eps22 = TE2_12,
```

```
          delta11 eps11 = TDE1_11, delta11 eps12 = TDE1_12,
          delta12 eps11 = TDE1_21, delta12 eps12 = TDE1_22,
          delta13 eps11 = TDE1_31, delta13 eps12 = TDE1_32,
          delta21 eps21 = TDE2_11, delta21 eps22 = TDE2_12,
          delta22 eps21 = TDE2_21, delta22 eps22 = TDE2_22,
          delta23 eps21 = TDE2_31, delta23 eps22 = TDE2_32;
     bounds                  /* Variances are positive */
          0.0 < phi11,   0.0 < phi22,   0.0 < phi33,
          0.0 < psi11,   0.0 < psi22,
          0.0 < TD1_11,  0.0 < TD1_22,  0.0 < TD1_33,
          0.0 < TD2_11,  0.0 < TD2_22,  0.0 < TD2_33,
          0.0 < TE1_11,  0.0 < TE1_22,
          0.0 < TE2_11,  0.0 < TE2_22;
     lincon gamma12=0, gamma22=0;
     /* 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 = 500 * (0.0391401498-0.0378779129);
     pval = 1 - probchi(G,2);
     print G,pval;
```

---



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 | | | |

---



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 | phi11 | . |
| Fbmi | phi22 | . |
| Ffat | phi33 | . |
| e1 | psi11 | . |
| e2 | psi22 | . |
| eps11 | TE1_11 | . |
| eps12 | TE1_22 | . |
| eps21 | TE2_11 | . |
| eps22 | TE2_22 | . |
| delta11 | TD1_11 | . |
| delta12 | TD1_22 | . |
| delta13 | TD1_33 | . |
| delta21 | TD2_11 | . |
| delta22 | TD2_22 | . |
| delta23 | TD2_33 | . |

Covariances Among Exogenous Variables

| Var1 | Var2 | Parameter | Estimate |
|---|---|---|---|
| Fage | Fbmi | phi12 | . |
| Fage | Ffat | phi13 | . |
| Fbmi | Ffat | phi23 | . |
| e1 | e2 | psi12 | . |
| eps11 | eps12 | TE1_12 | . |
| eps21 | eps22 | TE2_12 | . |
| eps11 | delta11 | TDE1_11 | . |
| eps12 | delta11 | TDE1_12 | . |
| eps11 | delta12 | TDE1_21 | . |
| eps12 | delta12 | TDE1_22 | . |
| delta11 | delta12 | TD1_12 | . |
| eps11 | delta13 | TDE1_31 | . |
| eps12 | delta13 | TDE1_32 | . |
| delta11 | delta13 | TD1_13 | . |
| delta12 | delta13 | TD1_23 | . |
| eps21 | delta21 | TDE2_11 | . |
| eps22 | delta21 | TDE2_12 | . |
| eps21 | delta22 | TDE2_21 | . |
| eps22 | delta22 | TDE2_22 | . |
| delta21 | delta22 | TD2_12 | . |
| eps21 | delta23 | TDE2_31 | . |
| eps22 | delta23 | TDE2_32 | . |
| delta21 | delta23 | TD2_13 | . |
| delta22 | delta23 | TD2_23 | . |

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 | phi11 | 147.24427 | Matrix Entry: _PHI_[1:1] |
| 8 | phi12 | 8.79461 | Matrix Entry: _PHI_[2:1] |
| 9 | phi22 | 12.33537 | Matrix Entry: _PHI_[2:2] |
| 10 | phi13 | 27.68039 | Matrix Entry: _PHI_[3:1] |
| 11 | phi23 | 22.57943 | Matrix Entry: _PHI_[3:2] |
| 12 | phi33 | 45.86815 | Matrix Entry: _PHI_[3:3] |
| 13 | psi11 | 2389 | Matrix Entry: _PHI_[4:4] |
| 14 | psi12 | 71.22487 | Matrix Entry: _PHI_[5:4] |
| 15 | psi22 | 75.27225 | Matrix Entry: _PHI_[5:5] |
| 16 | TE1_11 | 192.26932 | Matrix Entry: _PHI_[6:6] |

| | | | |
|---|---|---|---|
| 17 | TE1_12 | 39.74295 | Matrix Entry: _PHI_[7:6] |
| 18 | TE1_22 | 215.64902 | Matrix Entry: _PHI_[7:7] |
| 19 | TE2_11 | 338.32405 | Matrix Entry: _PHI_[8:8] |
| 20 | TE2_12 | -38.53896 | Matrix Entry: _PHI_[9:8] |
| 21 | TE2_22 | 15.48280 | Matrix Entry: _PHI_[9:9] |
| 22 | TDE1_11 | -0.37855 | Matrix Entry: _PHI_[10:6] |
| 23 | TDE1_12 | 10.18200 | Matrix Entry: _PHI_[10:7] |
| 24 | TD1_11 | 21.74398 | Matrix Entry: _PHI_[10:10] |
| 25 | TDE1_21 | -3.46658 | Matrix Entry: _PHI_[11:6] |
| 26 | TDE1_22 | 6.35643 | Matrix Entry: _PHI_[11:7] |
| 27 | TD1_12 | 1.33004 | Matrix Entry: _PHI_[11:10] |
| 28 | TD1_22 | 8.36053 | Matrix Entry: _PHI_[11:11] |
| 29 | TDE1_31 | 0.15593 | Matrix Entry: _PHI_[12:6] |
| 30 | TDE1_32 | 3.93632 | Matrix Entry: _PHI_[12:7] |
| 31 | TD1_13 | -1.58351 | Matrix Entry: _PHI_[12:10] |
| 32 | TD1_23 | 5.78119 | Matrix Entry: _PHI_[12:11] |
| 33 | TD1_33 | 14.22915 | Matrix Entry: _PHI_[12:12] |
| 34 | TDE2_11 | 1.94395 | Matrix Entry: _PHI_[13:8] |
| 35 | TDE2_12 | -6.39489 | Matrix Entry: _PHI_[13:9] |
| 36 | TD2_11 | 6.95289 | Matrix Entry: _PHI_[13:13] |
| 37 | TDE2_21 | 2.83802 | Matrix Entry: _PHI_[14:8] |
| 38 | TDE2_22 | -0.80271 | Matrix Entry: _PHI_[14:9] |
| 39 | TD2_12 | 0.02965 | Matrix Entry: _PHI_[14:13] |
| 40 | TD2_22 | 1.54368 | Matrix Entry: _PHI_[14:14] |
| 41 | TDE2_31 | -2.68759 | Matrix Entry: _PHI_[15:8] |
| 42 | TDE2_32 | -1.99128 | Matrix Entry: _PHI_[15:9] |
| 43 | TD2_13 | 2.03567 | Matrix Entry: _PHI_[15:13] |
| 44 | TD2_23 | -1.64710 | Matrix Entry: _PHI_[15:14] |
| 45 | TD2_33 | 11.34540 | Matrix Entry: _PHI_[15:15] |

---



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 | Rest arts | 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 | phi11 | 148.12838 | 9.79411 | 15.12 |
| Fbmi | phi22 | 12.54181 | 0.94050 | 13.34 |
| Ffat | phi33 | 46.99750 | 3.28849 | 14.29 |
| e1 | psi11 | 2391 | 161.53168 | 14.81 |
| e2 | psi22 | 75.69775 | 8.78257 | 8.62 |
| eps11 | TE1_11 | 195.80618 | 54.03321 | 3.62 |
| eps12 | TE1_22 | 207.71308 | 15.24803 | 13.62 |
| eps21 | TE2_11 | 336.03140 | 56.74542 | 5.92 |
| eps22 | TE2_22 | 25.20654 | 7.67288 | 3.29 |
| delta11 | TD1_11 | 22.30517 | 3.22022 | 6.93 |
| delta12 | TD1_22 | 8.61051 | 0.71704 | 12.01 |
| delta13 | TD1_33 | 13.95514 | 1.71930 | 8.12 |
| delta21 | TD2_11 | 6.30433 | 2.90105 | 2.17 |
| delta22 | TD2_22 | 1.28485 | 0.48547 | 2.65 |
| delta23 | TD2_33 | 11.46363 | 1.67508 | 6.84 |

Covariances Among Exogenous Variables

| Var1 | Var2 | Parameter | Estimate | Standard Error | t Value |
|---|---|---|---|---|---|
| Fage | Fbmi | phi12 | 8.53524 | 2.14246 | 3.98 |
| Fage | Ffat | phi13 | 28.67293 | 4.20356 | 6.82 |
| Fbmi | Ffat | phi23 | 21.07021 | 1.58695 | 13.28 |
| e1 | e2 | psi12 | 26.99445 | 23.13516 | 1.17 |
| eps11 | eps12 | TE1_12 | 2.37369 | 17.44389 | 0.14 |
| eps21 | eps22 | TE2_12 | 10.55839 | 12.14484 | 0.87 |
| eps11 | delta11 | TDE1_11 | 1.46571 | 9.28626 | 0.16 |
| eps12 | delta11 | TDE1_12 | 5.50639 | 4.26027 | 1.29 |
| eps11 | delta12 | TDE1_21 | -1.68780 | 4.05537 | -0.42 |
| eps12 | delta12 | TDE1_22 | 8.22814 | 2.38542 | 3.45 |
| delta11 | delta12 | TD1_12 | 2.41139 | 1.00109 | 2.41 |
| eps11 | delta13 | TDE1_31 | -1.67949 | 6.62998 | -0.25 |
| eps12 | delta13 | TDE1_32 | 0.90570 | 3.57876 | 0.25 |
| delta11 | delta13 | TD1_13 | -1.23726 | 1.62183 | -0.76 |
| delta12 | delta13 | TD1_23 | 8.07727 | 0.96844 | 8.34 |
| eps21 | delta21 | TDE2_11 | 0.83261 | 9.02367 | 0.09 |
| eps22 | delta21 | TDE2_12 | 2.24903 | 2.78751 | 0.81 |
| eps21 | delta22 | TDE2_21 | 0.09756 | 3.34404 | 0.03 |
| eps22 | delta22 | TDE2_22 | 2.97256 | 1.44467 | 2.06 |
| delta21 | delta22 | TD2_12 | 0.26655 | 0.76726 | 0.35 |
| eps21 | delta23 | TDE2_31 | -4.03672 | 6.65942 | -0.61 |
| eps22 | delta23 | TDE2_32 | 2.33466 | 2.56252 | 0.91 |
| delta21 | delta23 | TD2_13 | 1.97235 | 1.51921 | 1.30 |
| delta22 | delta23 | TD2_23 | 0.06895 | 0.74323 | 0.09 |

The CALIS Procedure
Covariance Structure Analysis: Maximum Likelihood Estimation

Manifest Variable Equations with Standardized Estimates

```
age1     =   0.9323 Fage     +  0.3618 delta11
bmi1     =   0.7700 Fbmi     +  0.6380 delta12
fat1     =   0.8781 Ffat     +  0.4785 delta13
cholest1 =   0.9636 Fcholest +  0.2673 eps11
diastol1 =   0.6433 Fdiastol +  0.7656 eps12
age2     =   0.9794 Fage     +  0.2020 delta21
bmi2     =   0.9524 Fbmi     +  0.3048 delta22
fat2     =   0.8966 Ffat     +  0.4428 delta23
cholest2 =   0.9399 Fcholest +  0.3415 eps21
diastol2 =   0.9238 Fdiastol +  0.3830 eps22
```

---



The CALIS Procedure
Covariance Structure Analysis: Maximum Likelihood Estimation

Latent Variable Equations with Standardized Estimates

```
Fcholest =   0.0357*Fage     + -0.0892*Fbmi     +  0.3027*Ffat
                    gamma11             gamma12             gamma13

                         +  0.9695 e1


Fdiastol =   0.0104*Fage     + -0.0308*Fbmi     +  0.7185*Ffat
                    gamma21             gamma22             gamma23

                         +  0.7184 e2
```

Squared Multiple Correlations

| | Variable | Error Variance | Total Variance | R-Square |
|---|---|---|---|---|
| 1 | age1 | 22.30517 | 170.43356 | 0.8691 |
| 2 | bmi1 | 8.61051 | 21.15232 | 0.5929 |
| 3 | fat1 | 13.95514 | 60.95264 | 0.7710 |
| 4 | cholest1 | 195.80618 | 2740 | 0.9285 |
| 5 | diastol1 | 207.71308 | 354.37056 | 0.4139 |
| 6 | age2 | 6.30433 | 154.43272 | 0.9592 |
| 7 | bmi2 | 1.28485 | 13.82666 | 0.9071 |

| | | | | |
|---|---|---|---|---|
| 8 | fat2 | 11.46363 | 58.46113 | 0.8039 |
| 9 | cholest2 | 336.03140 | 2881 | 0.8833 |
| 10 | diastol2 | 25.20654 | 171.86402 | 0.8533 |
| 11 | Fcholest | 2391 | 2545 | 0.0602 |
| 12 | Fdiastol | 75.69775 | 146.65747 | 0.4838 |

Correlations Among Exogenous Variables

| Var1 | Var2 | Parameter | Estimate |
|---|---|---|---|
| Fage | Fbmi | phi12 | 0.19802 |
| Fage | Ffat | phi13 | 0.34365 |
| Fbmi | Ffat | phi23 | 0.86786 |
| e1 | e2 | psi12 | 0.06345 |
| eps11 | eps12 | TE1_12 | 0.01177 |
| eps21 | eps22 | TE2_12 | 0.11472 |
| eps11 | delta11 | TDE1_11 | 0.02218 |
| eps12 | delta11 | TDE1_12 | 0.08090 |
| eps11 | delta12 | TDE1_21 | -0.04110 |
| eps12 | delta12 | TDE1_22 | 0.19456 |
| delta11 | delta12 | TD1_12 | 0.17400 |
| eps11 | delta13 | TDE1_31 | -0.03213 |
| eps12 | delta13 | TDE1_32 | 0.01682 |
| delta11 | delta13 | TD1_13 | -0.07013 |
| delta12 | delta13 | TD1_23 | 0.73686 |
| eps21 | delta21 | TDE2_11 | 0.01809 |
| eps22 | delta21 | TDE2_12 | 0.17841 |
| eps21 | delta22 | TDE2_21 | 0.00470 |
| eps22 | delta22 | TDE2_22 | 0.52233 |
| delta21 | delta22 | TD2_12 | 0.09366 |
| eps21 | delta23 | TDE2_31 | -0.06504 |
| eps22 | delta23 | TDE2_32 | 0.13734 |
| delta21 | delta23 | TD2_13 | 0.23201 |
| delta22 | delta23 | TD2_23 | 0.01796 |

---



Skipping a lot of output, just give the optimization results and some of the parameter estimates.

Optimization Results

| | | | |
|---|---|---|---|
| Iterations | 158 | Function Calls | 284 |
| Gradient Calls | 223 | Active Constraints | 2 |
| Objective Function | 0.0391401498 | Max Abs Gradient Element | 9.9301853E-6 |
| Slope of Search Direction | -4.894672E-8 | | |

ABSGCONV convergence criterion satisfied.

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

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 |

Skipping some more ...

The CALIS Procedure
Covariance Structure Analysis: Maximum Likelihood Estimation

Latent Variable Equations with Estimates

| | | | | | |
|---|---|---|---|---|---|
| Fcholest = | 0.1987*Fage | + | 0*Fbmi | + 1.6003*Ffat | |
| Std Err | 0.2018 gamma11 | | 0 gamma12 | 0.3681 gamma13 | |
| t Value | 0.9845 | | . | 4.3477 | |

+ 1.0000 e1

| | | | | | |
|---|---|---|---|---|---|
| Fdiastol = | 0.0149*Fage | + | 0*Fbmi | + 1.2178*Ffat | |
| Std Err | 0.0425 gamma21 | | 0 gamma22 | 0.0798 gamma23 | |
| t Value | 0.3500 | | . | 15.2689 | |

+ 1.0000 e2

Variances of Exogenous Variables

Skipping another couple of pages ...

---


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

G

0.6311185

PVAL

0.7293809