Structural Equation Modeling

Chapter 9

Comparing Groups

Merle Canfield

Structural Equation Modeling can be used to compare parameters across groups. Correlation matrices can be compared. Factor structures for two or more groups can be compared. Structural relationships can be compared.

The example presented here assumes that the reader understands the methods used in the chapter "Running EQS from a Covariance Matrix." That chapter may need to be consulted to get things to work. There are two data sets used in this example: the subjects in one data set are females (LSQRNDF.ESS) and the subjects in the second data are males (LSQRNDM.ESS). Since there are almost 200 variables in these data sets one first needs to select a sets, compute a covariance matrix (see the "Running EQS from a Covariance Matrix) for females, compute a covariance matrix for males, run the model on each set, and finally compare the two models.

The first model to be tested is confirmatory factory analysis. The following diagram presents the model.
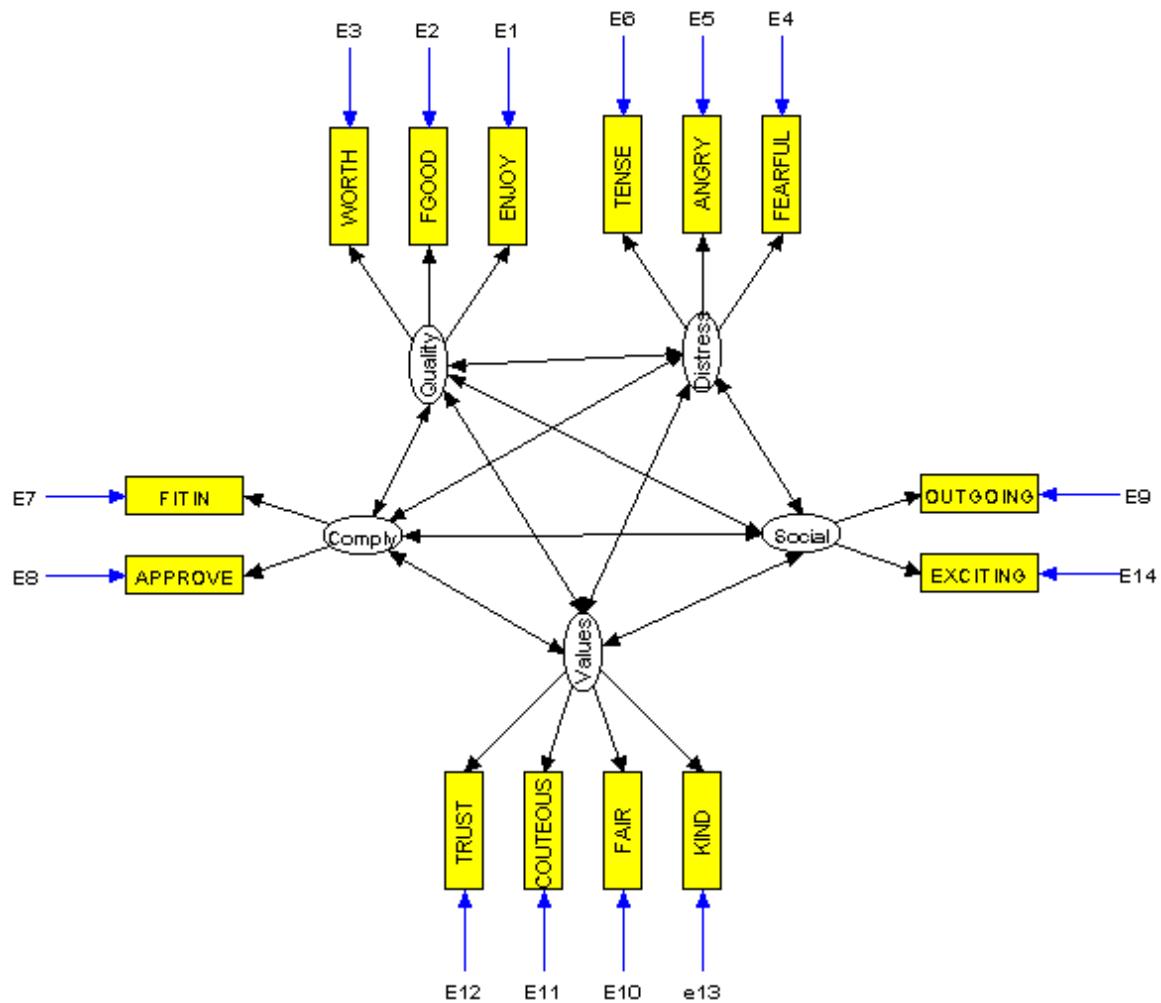
     The confirmatory factor analysis for females was computee in the following manner:
Click File.
Click Open.
Enter the file name "\eqsw\slqrndf.ess"
Click OK.
Click Analysis.
Click Correlations.
Hold down Ctrl and click on the variables enjoy, fgood, worth, fearful, angry, tense, fitin, approve, fair, couteous, trust, kind, outgoing, and exciting.
Select box labeled USE Complete Pairs.
Select box labeled Put Matrix in Data Editor.

Click OK execute correlation analysis.
When the computer reports Matrix Done, click OK.
Click on diagrammer (puppy paw on button bar).
Draw diagram.
Save file.
Click on Build_EQS.
Click on ____/specification.
Give the output file a name.
Click OK.
Save file.
Click on Build_EQS.
Click on Run EQS/386.
Save output file.
Save Syntax file (jobstream).
The Syntax file created is: LSQMODF.EQS

```
/TITLE
Confirmatory Facotry Analsysis      Women
/SPECIFICATIONS
 !DATA='LSQMATFC.ESS'; VARIABLES= 14; CASES=  183;
 VARIABLES= 14; CASES=  183;
 METHODS=ML;
 MATRIX=COVARIANCE;
/LABELS
V1=ENJOY; V2=FGOOD; V3=WORTH; V4=FEARFUL; V5=ANGRY;
V6=TENSE; V7=FITIN; V8=APPROVE; V9=OUTGOING; V10=FAIR;
V11=COUTEOUS; V12=TRUST; V13=KIND; V14=EXCITING;
/EQUATIONS
V1 =  + *F1  + E1;
V2 =  + *F1  + E2;
V3 =  + *F1  + E3;
V4 =  + *F2  + E4;
V5 =  + *F2  + E5;
V6 =  + *F2  + E6;
V7 =  + *F4  + E7;
V8 =  + *F4  + E8;
V9 =  + *F5  + E9;
V10 =  + *F3  + E10;
V11 =  + *F3  + E11;
V12 =  + *F3  + E12;
V14 =  + *F5  + E14;
/VARIANCES
F1 = 1.00;
F2 = 1.00;
```

```
F3  = 1.00;
F4  = 1.00;
F5  = 1;
E1  = *;
E2  = *;
E3  = *;
E4  = *;
E5  = *;
E6  = *;
E7  = *;
E8  = *;
E9  = *;
E10 = *;
E11 = *;
E12 = *;
E14 = *;
/COVARIANCES
f1,f2 =*;
f1,f3 =*;
f1,f4 =*;
f1,f5 =*;
f2,f3 =*;
f2,f4 =*;
f2,f5 =*;
f3,f4 =*;
f3,f5 =*;
f4,f5 =*;
/OUTPUT
 parameters;
 standard errors;
 listing;
 data='EQSOUT&.ETS';
/MATRIX
     3.985
     1.578     3.079
     1.408     2.180     3.331
    -0.474    -0.652    -0.855     2.365
    -0.564    -0.603    -0.590     1.107     2.039
    -1.216    -0.861    -0.663     1.117     1.378     3.254
     0.342     0.634     0.863    -0.723    -0.414    -0.390     3.565
     0.635     1.150     1.300    -0.766    -0.917    -0.803     1.452
     2.460
     0.804     1.206     1.390    -0.434    -0.412    -0.377     1.084
     1.476     3.810
```

```
0.262     0.484     0.583    -0.143    -0.084    -0.030     0.443
0.491     0.341     1.011
0.261     0.401     0.608    -0.089    -0.175     0.103     0.346
0.616     0.338     0.674     1.139
0.269     0.396     0.318    -0.098    -0.059    -0.158     0.226
0.316     0.133     0.369     0.310     0.560
0.210     0.385     0.372    -0.255    -0.455    -0.120     0.439
0.490     0.297     0.435     0.541     0.270     0.917
1.107     1.442     1.652    -0.675    -0.665    -0.692     1.079
0.986     1.367     0.326     0.196     0.203     0.377     3.031
```
/END

The goodness of fit and standardized solution follows:

```
GOODNESS OF FIT SUMMARY

INDEPENDENCE MODEL CHI-SQUARE =       805.544 ON    78 DEGREES OF FREEDOM

INDEPENDENCE AIC =   649.54436   INDEPENDENCE CAIC =   321.20444
      MODEL AIC =   -29.35524         MODEL CAIC =  -260.87698

CHI-SQUARE =       80.645 BASED ON     55 DEGREES OF FREEDOM
PROBABILITY VALUE FOR THE CHI-SQUARE STATISTIC IS     0.01372
THE NORMAL THEORY RLS CHI-SQUARE FOR THIS ML SOLUTION IS        83.510.

BENTLER-BONETT NORMED    FIT INDEX=      0.900
BENTLER-BONETT NONNORMED FIT INDEX=      0.950
COMPARATIVE FIT INDEX            =      0.965

STANDARDIZED SOLUTION:

ENJOY   =V1 =   .502*F1   + .865 E1
FGOOD   =V2 =   .811*F1   + .584 E2
WORTH   =V3 =   .839*F1   + .544 E3
FEARFUL =V4 =   .637*F2   + .771 E4
ANGRY   =V5 =   .796*F2   + .605 E5
TENSE   =V6 =   .659*F2   + .752 E6
FITIN   =V7 =   .549*F4   + .836 E7
APPROVE =V8 =   .893*F4   + .451 E8
```

```
OUTGOING=V9   =    .606*F5    + .796 E9
   FAIR  =V10 =    .829*F3    + .559 E10
COUTEOUS=V11 =    .751*F3    + .661 E11
 TRUST  =V12 =    .573*F3    + .820 E12
EXCITING=V14 =    .664*F5    + .748 E14
```

The same procedure was completed for males with the following results.

```
/TITLE
Confimatory Factory Analysis     Men
/SPECIFICATIONS
 !DATA='C:\EQSW\LSQMATMC.ESS'; VARIABLES= 14; CASES=  218;
 VARIABLES= 14; CASES=  218;
 METHODS=ML;
 MATRIX=COVARIANCE;
/LABELS
V1=ENJOY; V2=FGOOD; V3=WORTH; V4=FEARFUL; V5=ANGRY;
V6=TENSE; V7=FITIN; V8=APPROVE; V9=OUTGOING; V10=FAIR;
V11=COUTEOUS; V12=TRUST; V13=KIND; V14=EXCITING;
/EQUATIONS
V1 =  + *F1  + E1;
V2 =  + *F1  + E2;
V3 =  + *F1  + E3;
V4 =  + *F2  + E4;
V5 =  + *F2  + E5;
V6 =  + *F2  + E6;
V7 =  + *F4  + E7;
V8 =  + *F4  + E8;
V9 =  + *F5  + E9;
V10 =  + *F3  + E10;
V11 =  + *F3  + E11;
V12 =  + *F3  + E12;
V14 =  + *F5  + E14;
/VARIANCES
F1 = 1.00;
F2 = 1.00;
F3 = 1.00;
F4 = 1.00;
F5 = 1;
E1 = *;
E2 = *;
E3 = *;
E4 = *;
E5 = *;
```

E6 = *;
E7 = *;
E8 = *;
E9 = *;
E10 = *;
E11 = *;
E12 = *;
E14 = *;
/COVARIANCES
f1,f2 = *;
f1,f3 = *;
f1,f4 = *;
f1,f5 = *;
f2,f3 = *;
f2,f4 = *;
f2,f5 = *;
f3,f4 = *;
f3,f5 = *;
f4,f5 = *;
/OUTPUT
 parameters;
 standard errors;
 listing;
 data='EQSOUT&.ETS';
/MATRIX
```
    3.877
    1.759     2.853
    1.301     2.060     3.319
   -1.151    -0.888    -0.991     2.598
   -1.156    -0.934    -0.900     1.579     2.958
   -1.550    -1.099    -1.118     1.927     1.911     3.699
    0.951     1.460     1.462    -0.909    -0.557    -0.871     3.028
    1.431     1.588     1.422    -1.230    -1.096    -1.110     1.538
    2.672
    0.841     1.408     1.710    -0.551    -0.296    -0.345     1.355
    0.803     4.273
    0.344     0.638     0.515    -0.429    -0.370    -0.292     0.761
    0.571     0.365     0.990
    0.486     0.570     0.582    -0.416    -0.450    -0.301     0.717
    0.549     0.542     0.553     1.094
    0.297     0.345     0.311    -0.417    -0.370    -0.345     0.229
    0.334     0.160     0.299     0.319     0.657
    0.334     0.638     0.609    -0.365    -0.581    -0.528     0.475
    0.521     0.299     0.355     0.516     0.294     0.853
```

```
    0.943     1.213     1.619    -0.751    -0.800    -0.563     1.335
    0.830     1.374     0.665     0.545     0.338     0.356     4.437
/END
```

The goodness of fit and standardized solution.

```
GOODNESS OF FIT SUMMARY

INDEPENDENCE MODEL CHI-SQUARE =      1063.520 ON    78 DEGREES OF FREEDOM

INDEPENDENCE AIC =   907.51975   INDEPENDENCE CAIC =    565.52914
      MODEL AIC =     4.58777         MODEL CAIC =   -236.55946

CHI-SQUARE =      114.588 BASED ON    55 DEGREES OF FREEDOM
PROBABILITY VALUE FOR THE CHI-SQUARE STATISTIC IS LESS THAN 0.001
THE NORMAL THEORY RLS CHI-SQUARE FOR THIS ML SOLUTION IS        112.253.

BENTLER-BONETT NORMED    FIT INDEX=      0.892
BENTLER-BONETT NONNORMED FIT INDEX=      0.914
COMPARATIVE FIT INDEX            =      0.940
```

```
STANDARDIZED SOLUTION:




ENJOY   =V1  =  .573*F1    + .819 E1
FGOOD   =V2  =  .857*F1    + .515 E2
WORTH   =V3  =  .775*F1    + .632 E3
FEARFUL =V4  =  .803*F2    + .596 E4
ANGRY   =V5  =  .724*F2    + .690 E5
TENSE   =V6  =  .776*F2    + .631 E6
FITIN   =V7  =  .701*F4    + .713 E7
APPROVE =V8  =  .772*F4    + .636 E8
OUTGOING=V9  =  .577*F5    + .816 E9
  FAIR  =V10 =  .742*F3    + .671 E10
COUTEOUS=V11 =  .719*F3    + .695 E11
TRUST   =V12 =  .508*F3    + .861 E12
EXCITING=V14 =  .547*F5    + .837 E14
```

The two Syntax files are combined as follows:

File Name = LSQCONFM.EQS

/TITLE
Confirmatory Facotry Analsysis   Men
/SPECIFICATIONS
 !DATA='LSQMATFC.ESS'; VARIABLES= 14; CASES= 183;
 VARIABLES= 14; CASES= 183; groups=2;
 METHODS=ML;
 MATRIX=COVARIANCE;
/LABELS
V1=ENJOY; V2=FGOOD; V3=WORTH; V4=FEARFUL; V5=ANGRY;
V6=TENSE; V7=FITIN; V8=APPROVE; V9=OUTGOING; V10=FAIR;
V11=COUTEOUS; V12=TRUST; V13=KIND; V14=EXCITING;
/EQUATIONS
V1 = + *F1 + E1;
V2 = + *F1 + E2;
V3 = + *F1 + E3;
V4 = + *F2 + E4;
V5 = + *F2 + E5;
V6 = + *F2 + E6;
V7 = + *F4 + E7;
V8 = + *F4 + E8;
V9 = + *F5 + E9;
V10 = + *F3 + E10;
V11 = + *F3 + E11;
V12 = + *F3 + E12;
V14 = + *F5 + E14;
/VARIANCES
F1 = 1.00;
F2 = 1.00;
F3 = 1.00;
F4 = 1.00;
F5 = 1;
E1 = *;
E2 = *;
E3 = *;
E4 = *;
E5 = *;
E6 = *;
E7 = *;
E8 = *;
E9 = *;
E10 = *;

E11 = *;

E12 = *;

E14 = *;

/COVARIANCES

f1,f2 =*;

f1,f3 =*;

f1,f4 =*;

f1,f5 =*;

f2,f3 =*;

f2,f4 =*;

f2,f5 =*;

f3,f4 =*;

f3,f5 =*;

f4,f5 =*;

/MATRIX

```
    3.985
    1.578     3.079
    1.408     2.180     3.331
   -0.474    -0.652    -0.855     2.365
   -0.564    -0.603    -0.590     1.107     2.039
   -1.216    -0.861    -0.663     1.117     1.378     3.254
    0.342     0.634     0.863    -0.723    -0.414    -0.390     3.565
    0.635     1.150     1.300    -0.766    -0.917    -0.803     1.452
    2.460
    0.804     1.206     1.390    -0.434    -0.412    -0.377     1.084
    1.476     3.810
    0.262     0.484     0.583    -0.143    -0.084    -0.030     0.443
    0.491     0.341     1.011
    0.261     0.401     0.608    -0.089    -0.175     0.103     0.346
    0.616     0.338     0.674     1.139
    0.269     0.396     0.318    -0.098    -0.059    -0.158     0.226
    0.316     0.133     0.369     0.310     0.560
    0.210     0.385     0.372    -0.255    -0.455    -0.120     0.439
    0.490     0.297     0.435     0.541     0.270     0.917
    1.107     1.442     1.652    -0.675    -0.665    -0.692     1.079
    0.986     1.367     0.326     0.196     0.203     0.377     3.031
```

/END

/TITLE

Confimatory Factory Analysis   Women

/SPECIFICATIONS

 !DATA='C:\EQSW\LSQMATMC.ESS'; VARIABLES= 14; CASES= 218;

 VARIABLES= 14; CASES= 218; groups=2;

 METHODS=ML;

 MATRIX=COVARIANCE;

/LABELS

V1=ENJOY; V2=FGOOD; V3=WORTH; V4=FEARFUL; V5=ANGRY;

V6=TENSE; V7=FITIN; V8=APPROVE; V9=OUTGOING; V10=FAIR;

V11=COUTEOUS; V12=TRUST; V13=KIND; V14=EXCITING;

/lmtest

/EQUATIONS

V1 = + *F1 + E1;

V2 = + *F1 + E2;

V3 = + *F1 + E3;

V4 = + *F2 + E4;

V5 = + *F2 + E5;

V6 = + *F2 + E6;

V7 = + *F4 + E7;

V8 = + *F4 + E8;

V9 = + *F5 + E9;

V10 = + *F3 + E10;

V11 = + *F3 + E11;

V12 = + *F3 + E12;

V14 = + *F5 + E14;

/VARIANCES

F1 = 1.00;

F2 = 1.00;

F3 = 1.00;

F4 = 1.00;

F5 = 1;

E1 = *;

E2 = *;

E3 = *;

E4 = *;

E5 = *;

E6 = *;

E7 = *;

E8 = *;

E9 = *;

E10 = *;

E11 = *;

E12 = *;

E14 = *;

/COVARIANCES

f1,f2=*;

f1,f3=*;

f1,f4=*;

f1,f5=*;

f2,f3=*;

f2,f4 = ∗;
f2,f5 = ∗;
f3,f4 = ∗;
f3,f5 = ∗;
f4,f5 = ∗;
/MATRIX
    3.877
    1.759   2.853
    1.301   2.060   3.319
    -1.151   -0.888   -0.991   2.598
    -1.156   -0.934   -0.900   1.579   2.958
    -1.550   -1.099   -1.118   1.927   1.911   3.699
    0.951   1.460   1.462   -0.909   -0.557   -0.871   3.028
    1.431   1.588   1.422   -1.230   -1.096   -1.110   1.538
    2.672
    0.841   1.408   1.710   -0.551   -0.296   -0.345   1.355
    0.803   4.273
    0.344   0.638   0.515   -0.429   -0.370   -0.292   0.761
    0.571   0.365   0.990
    0.486   0.570   0.582   -0.416   -0.450   -0.301   0.717
    0.549   0.542   0.553   1.094
    0.297   0.345   0.311   -0.417   -0.370   -0.345   0.229
    0.334   0.160   0.299   0.319   0.657
    0.334   0.638   0.609   -0.365   -0.581   -0.528   0.475
    0.521   0.299   0.355   0.516   0.294   0.853
    0.943   1.213   1.619   -0.751   -0.800   -0.563   1.335
    0.830   1.374   0.665   0.545   0.338   0.356   4.437
/CON
(1,V1   ,F1)=(2,V1   ,F1);
(1,V2   ,F1)=(2,V2   ,F1);
(1,V3   ,F1)=(2,V3   ,F1);
(1,V4   ,F2)=(2,V4   ,F2);
(1,V5   ,F2)=(2,V5   ,F2);
(1,V6   ,F2)=(2,V6   ,F2);
(1,V7   ,F4)=(2,V7   ,F4);
(1,V8   ,F4)=(2,V8   ,F4);
(1,V9   ,F5)=(2,V9   ,F5);
(1,V10 ,F3)=(2,V10 ,F3);
(1,V11 ,F3)=(2,V11 ,F3);
(1,V12 ,F3)=(2,V12 ,F3);
(1,V14 ,F5)=(2,V14 ,F5);
(1,F1,F2)= (2,F1,F2);
(1,F1,F3)= (2,F1,F3);
(1,F1,F4)= (2,F1,F4);

```
(1,F1,F5)= (2,F1,F5);
(1,F2,F3)= (2,F2,F3);
(1,F2,F4)= (2,F2,F4);
(1,F2,F5)= (2,F2,F5);
(1,F3,F4)= (2,F3,F4);
(1,F3,F5)= (2,F3,F5);
(1,F4,F5)= (2,F4,F5);
/END
```

There are four changes or additions to the Syntax files:
GROUPS=2 is placed in the SPECIFICATION paragraph.
The LMTEST is added as a command.
The CONSTRIANTS paragraph indicates which parameters are to be assessed.
The CONSTRIANTS paragraph is immediately before the END command of the last Syntax file.

The goodness of fit and Lagrange Multipliers (tests of significance) follow:

```
    STANDARDIZED SOLUTION:


 ENJOY   =V1  =   .528*F1   + .849 E1
 FGOOD   =V2  =   .815*F1   + .579 E2
 WORTH   =V3  =   .815*F1   + .580 E3
 FEARFUL =V4  =   .712*F2   + .702 E4
 ANGRY   =V5  =   .798*F2   + .603 E5
 TENSE   =V6  =   .716*F2   + .698 E6
 FITIN   =V7  =   .600*F4   + .800 E7
 APPROVE =V8  =   .827*F4   + .562 E8
 OUTGOING=V9  =   .604*F5   + .797 E9
   FAIR  =V10 =   .808*F3   + .590 E10
 COUTEOUS=V11 =   .735*F3   + .679 E11
 TRUST   =V12 =   .564*F3   + .826 E12
 EXCITING=V14 =   .674*F5   + .739 E14


    STANDARDIZED SOLUTION:


 ENJOY   =V1  =   .550*F1   + .835 E1
 FGOOD   =V2  =   .862*F1   + .507 E2
 WORTH   =V3  =   .791*F1   + .612 E3
 FEARFUL =V4  =   .767*F2   + .642 E4
 ANGRY   =V5  =   .709*F2   + .705 E5
 TENSE   =V6  =   .748*F2   + .664 E6
 FITIN   =V7  =   .690*F4   + .723 E7
 APPROVE =V8  =   .788*F4   + .616 E8
 OUTGOING=V9  =   .568*F5   + .823 E9
```

```
    FAIR   =V10 =   .777*F3    + .629 E1O
COUTEOUS=V11 =   .726*F3    + .688 E11
TRUST   =V12 =   .513*F3    + .859 E12
EXCITING=V14 =   .545*F5    + .839 E14
```

GOODNESS OF FIT SUMMARY

INDEPENDENCE MODEL CHI-SQUARE =   1869.064 ON   156 DEGREES OF FREEDOM

INDEPENDENCE AIC = 1557.06415   INDEPENDENCE CAIC =   778.00617

       MODEL AIC =   -34.05753   MODEL CAIC = -698.25440

CHI-SQUARE =   231.942 BASED ON   133 DEGREES OF FREEDOM
PROBABILITY VALUE FOR THE CHI-SQUARE STATISTIC IS LESS THAN 0.001

BENTLER-BONETT NORMED   FIT INDEX=   0.876
BENTLER-BONETT NONNORMED FIT INDEX=   0.932
COMPARATIVE FIT INDEX   =   0.942

LAGRANGE MULTIPLIER TEST (FOR RELEASING CONSTRAINTS)

CONSTRAINTS TO BE RELEASED ARE:

        CONSTRAINTS FROM GROUP 2

        CONSTR: 1 (1,V1,F1)-(2,V1,F1)=0;   0.292   0.589
    CONSTR: 2 (1,V2,F1)-(2,V2,F1)=0;   0.010   0.920
    CONSTR: 3 (1,V3,F1)-(2,V3,F1)=0;   1.588   0.208
    CONSTR: 4 (1,V4,F2)-(2,V4,F2)=0;   2.277   0.131
    CONSTR: 5 (1,V5,F2)-(2,V5,F2)=0;   0.000   0.991
    CONSTR: 6 (1,V6,F2)-(2,V6,F2)=0;   1.431   0.232
    CONSTR: 7 (1,V7,F4)-(2,V7,F4)=0;   1.009   0.315
    CONSTR: 8 (1,V8,F4)-(2,V8,F4)=0;   1.515   0.218
    CONSTR: 9 (1,V9,F5)-(2,V9,F5)=0;   0.049   0.824
    CONSTR: 10 (1,V10,F3)-(2,V10,F3)=   1.167   0.2800;
    CONSTR: 11 (1,V11,F3)-(2,V11,F3)=   0.256   0.6130;
    CONSTR: 12 (1,V12,F3)-(2,V12,F3)=   0.048   0.8260;
    CONSTR: 13 (1,V14,F5)-(2,V14,F5)=   0.512   0.4740;
    CONSTR: 14 (1,F1,F2)-(2,F1,F2)=0;   0.001   0.982
    CONSTR: 15 (1,F1,F3)-(2,F1,F3)=0;   1.904   0.168
    CONSTR: 16 (1,F1,F4)-(2,F1,F4)=0;   13.416   0.000

```
CONSTR: 17  (1,F1,F5)-(2,F1,F5)=0;     0.001     0.969
CONSTR: 18  (1,F2,F3)-(2,F2,F3)=0;     5.409     0.020
CONSTR: 19  (1,F2,F4)-(2,F2,F4)=0;     0.646     0.421
CONSTR: 20  (1,F2,F5)-(2,F2,F5)=0;     0.392     0.531
CONSTR: 21  (1,F3,F4)-(2,F3,F4)=0;     0.004     0.949
CONSTR: 22  (1,F3,F5)-(2,F3,F5)=0;     5.359     0.021
CONSTR: 23  (1,F4,F5)-(2,F4,F5)=0;     4.666     0.031
```

UNIVARIATE TEST STATISTICS:

NO	CONSTRAINT	CHI-SQUARE	PROBABILITY
1	CONSTR: 1	0.292	0.589
2	CONSTR: 2	0.010	0.920
3	CONSTR: 3	1.588	0.208
4	CONSTR: 4	2.277	0.131
5	CONSTR: 5	0.000	0.991
6	CONSTR: 6	1.431	0.232
7	CONSTR: 7	1.009	0.315
8	CONSTR: 8	1.515	0.218
9	CONSTR: 9	0.049	0.824
10	CONSTR: 10	1.167	0.280
11	CONSTR: 11	0.256	0.613
12	CONSTR: 12	0.048	0.826
13	CONSTR: 13	0.512	0.474
14	CONSTR: 14	0.001	0.982
15	CONSTR: 15	1.904	0.168
16	CONSTR: 16	13.416	0.000
17	CONSTR: 17	0.001	0.969
18	CONSTR: 18	5.409	0.020
19	CONSTR: 19	0.646	0.421
20	CONSTR: 20	0.392	0.531
21	CONSTR: 21	0.004	0.949
22	CONSTR: 22	5.359	0.021
23	CONSTR: 23	4.666	0.031

CUMULATIVE MULTIVARIATE STATISTICS	UNIVARIATE INCREMENT
----------------------------------	--------------------

STEP	PARAMETER	CHI-SQUARE	D.F.	PROBABILITY	CHI-SQUARE	PROBABILITY
1	CONSTR: 16	13.416	1	0.000	13.416	0.000
2	CONSTR: 18	17.083	2	0.000	3.667	0.056
3	CONSTR: 22	20.226	3	0.000	3.143	0.076
4	CONSTR: 4	22.623	4	0.000	2.397	0.122
5	CONSTR: 6	24.947	5	0.000	2.324	0.127
6	CONSTR: 21	27.165	6	0.000	2.218	0.136
7	CONSTR: 8	28.919	7	0.000	1.755	0.185
8	CONSTR: 20	30.687	8	0.000	1.768	0.184
9	CONSTR: 3	31.992	9	0.000	1.305	0.253
10	CONSTR: 10	33.123	10	0.000	1.131	0.287
11	CONSTR: 7	34.135	11	0.000	1.012	0.314
12	CONSTR: 15	35.119	12	0.000	0.984	0.321
13	CONSTR: 14	35.598	13	0.001	0.479	0.489
14	CONSTR: 19	36.214	14	0.001	0.615	0.433
15	CONSTR: 5	36.701	15	0.001	0.488	0.485
16	CONSTR: 1	37.057	16	0.002	0.355	0.551
17	CONSTR: 23	37.296	17	0.003	0.239	0.625
18	CONSTR: 11	37.432	18	0.005	0.136	0.712
19	CONSTR: 12	37.507	19	0.007	0.076	0.783
20	CONSTR: 13	37.570	20	0.010	0.063	0.802
21	CONSTR: 9	37.603	21	0.014	0.033	0.856
22	CONSTR: 2	37.639	22	0.020	0.036	0.850
23	CONSTR: 17	37.639	23	0.028	0.001	0.981

The same set of procedures was performed for the following diagram.
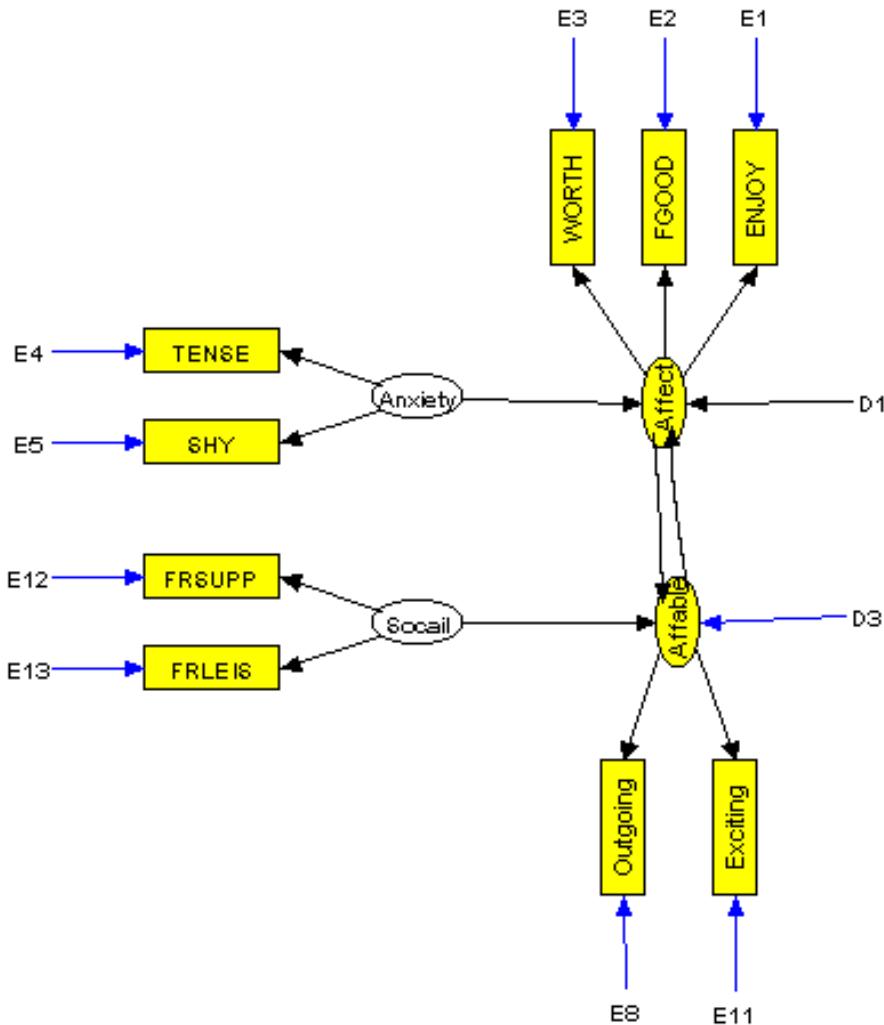
The model never worked so the arrow from Affect to Afable was eliminated. The following Syntax file was used to compute the model for females.

File Name = LSQMODF.EQS

```
/TITLE
Model for    Female
/SPECIFICATIONS
 !DATA='C:\EQSW\LSQMATF.ESS'; VARIABLES= 13; CASES=  208;
 VARIABLES= 13; CASES=  208;
 METHODS=ML;
 MATRIX=COVARIANCE;
/LABELS
V1=ENJOY; V2=FGOOD; V3=WORTH; V4=TENSE; V5=SHY;
V6=FITIN; V7=OUTGOING; V8=COPERTIV; V9=ARRANGE; V10=INCLUDED;
```

V11=EXCITING; V12=FRSUPP; V13=FRLEIS;

/EQUATIONS

V1 = + *F1 + E1;

V2 = + *F1 + E2;

V3 = + F1 + E3;

V4 = + *F2 + E4;

v5 = *f2 + e5;

V7 = + *F3 + E7;

V11 = + F3 + E11;

V12 = *F4 + E12;

V13 = + *F4 + E13;

F1 = + *F2 + *F3 + D1;

F3 = + *F4 + D3;

/VARIANCES

F2 = 1.00;

F4 = 1.00;

E1 = *;

E2 = *;

E3 = *;

E4 = *;

e5=*;

E7 = *;

E11 = *;

E12 = *;

E13 = *;

D1 = *;

D3 = *;

/COVARIANCES

/OUTPUT

 parameters;

 standard errors;

 listing;

 data='EQSOUT&.ETS';

/MATRIX

3.877						
1.759	2.853					
1.301	2.060	3.319				
-1.550	-1.099	-1.118	3.660			
-0.342	-0.284	-0.196	0.474	0.419		
0.951	1.460	1.462	-0.871	-0.179	3.005	
0.841	1.408	1.710	-0.345	-0.286	1.355	4.276
0.717	1.047	0.895	-0.527	-0.185	0.916	1.024
1.637						
0.167	1.097	1.498	-0.145	-0.146	1.038	1.041

```
0.745     4.464
0.744     0.907     0.865    -0.404    -0.209     1.050     1.198
0.833     1.436     3.186
0.943     1.213     1.619    -0.563    -0.118     1.335     1.374
0.712     1.855     1.234     4.428
0.789     0.972     1.038    -0.050    -0.174     1.059     1.100
0.707     1.245     1.602     0.634     5.496
1.072     0.688     0.247    -0.171    -0.097     0.578     0.292
0.066     0.100     0.624     0.035     1.929     3.986
```
/END

The goodness of fit and standarized solution follow:

GOODNESS OF FIT SUMMARY

INDEPENDENCE MODEL CHI-SQUARE =   463.733 ON   36 DEGREES OF FREEDOM

INDEPENDENCE AIC =   391.73311   INDEPENDENCE CAIC =   235.58174
       MODEL AIC =   16.52293   MODEL CAIC =   -87.57799

CHI-SQUARE =   64.523 BASED ON   24 DEGREES OF FREEDOM
PROBABILITY VALUE FOR THE CHI-SQUARE STATISTIC IS LESS THAN 0.001
THE NORMAL THEORY RLS CHI-SQUARE FOR THIS ML SOLUTION IS   65.005.

BENTLER-BONETT NORMED   FIT INDEX=   0.861
BENTLER-BONETT NONNORMED FIT INDEX=   0.858
COMPARATIVE FIT INDEX   =   0.905

STANDARDIZED SOLUTION:

ENJOY   =V1 =   .563*F1   + .827 E1
FGOOD   =V2 =   .833*F1   + .553 E2
WORTH   =V3 =   .778 F1   + .628 E3
TENSE   =V4 =   .904*F2   + .427 E4
  SHY   =V5 =   .423*F2   + .906 E5
OUTGOING=V7 =   .594*F3   + .805 E7
EXCITING=V11 =   .499 F3   + .866 E11
FRSUPP =V12 =   .888*F4   + .459 E12
FRLEIS =V13 =   .464*F4   + .886 E13
   F1   =F1 =   .818*F3   +-.421*F2   + .393 D1
   F3   =F3 =   .400*F4   + .917 D3

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```
```

The Syntax file for males:

File Name = LSQMODM.EQS

```
/TITLE
MODEL FOR MALES
/SPECIFICATIONS
 !DATA='C:\EQSW\LSQMATM.ESS'; VARIABLES= 13; CASES=  178;
 VARIABLES= 13; CASES=  178;
 METHODS=ML;
 MATRIX=COVARIANCE;
/LABELS
V1=ENJOY; V2=FGOOD; V3=WORTH; V4=TENSE; V5=SHY;
V6=FITIN; V7=OUTGOING; V8=COPERTIV; V9=ARRANGE; V10=INCLUDED;
V11=EXCITING; V12=FRSUPP; V13=FRLEIS;
/TEC
  ITR=100;
/EQUATIONS
V1 =  + *F1  + E1;
V2 =  + F1  + E2;
V3 =  + *F1  + E3;
V4=*F2+E4;
V5 =  + *F2  + E5;
V7 =  + *F3  + E7;
V11 =  + F3  + E11;
V12 =  + *F4  + E12;
V13 =  + *F4  + E13;
F1 =  + *F2  + *F3  + D1;
F3 =  + *F4  + D3;
/VARIANCES
F2  = 1.00;
F4  = 1.00;
E1  = *;
E2  = *;
E3  = *;
E4=*;
E5  = *;
E7  = *;
E11  = *;
E12  = *;
E13  = *;
D1  = *;
D3  = *;
```

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```
/COVARIANCES
/OUTPUT
 parameters;
 standard errors;
 listing;
 data='EQSOUT&.ETS';
/MATRIX
      3.985
      1.578      3.079
      1.408      2.180      3.331
     -1.216     -0.861     -0.663      3.237
     -0.137     -0.270     -0.304      0.214      0.401
      0.342      0.634      0.863     -0.390     -0.222      3.554
      0.804      1.206      1.390     -0.377     -0.348      1.084      3.684
      0.537      0.848      0.693     -0.210     -0.177      0.628      0.528
      2.041
     -0.260      0.690      1.033      0.345     -0.274      0.691      1.046
      0.654      3.869
      0.341      0.958      0.875      0.333     -0.173      0.928      1.070
      0.659      1.347      3.508
      1.107      1.442      1.652     -0.692     -0.289      1.079      1.367
      0.430      1.080      1.495      3.233
      0.080      0.435      0.313     -0.162     -0.181      1.117      0.490
      0.413      0.367      0.442      0.601      4.257
      0.671      0.274      0.262     -0.254      0.040      0.901      0.373
      0.075      0.030      0.563      0.788      2.461      4.339
/END
```

The goodness of fit and standardized solution.

 GOODNESS OF FIT SUMMARY

 INDEPENDENCE MODEL CHI-SQUARE =   401.860 ON   36 DEGREES OF FREEDOM

 INDEPENDENCE AIC =   329.86024   INDEPENDENCE CAIC =   179.31603
        MODEL AIC =   8.67115   MODEL CAIC =   -91.69166

 CHI-SQUARE =   56.671 BASED ON   24 DEGREES OF FREEDOM
 PROBABILITY VALUE FOR THE CHI-SQUARE STATISTIC IS LESS THAN 0.001
 THE NORMAL THEORY RLS CHI-SQUARE FOR THIS ML SOLUTION IS   55.606.

 BENTLER-BONETT NORMED   FIT INDEX=   0.859
 BENTLER-BONETT NONNORMED FIT INDEX=   0.866
 COMPARATIVE FIT INDEX   =   0.911

STANDARDIZED SOLUTION:

```
ENJOY   =V1  =   .507*F1   + .862 E1
FGOOD   =V2  =   .819 F1   + .574 E2
WORTH   =V3  =   .803*F1   + .596 E3
TENSE   =V4  =   .543*F2   + .840 E4
  SHY   =V5  =   .346*F2   + .938 E5
OUTGOING=V7  =   .551*F3   + .834 E7
EXCITING=V11 =   .741 F3   + .672 E11
FRSUPP  =V12 =   .716*F4   + .698 E12
FRLEIS  =V13 =   .799*F4   + .601 E13
  F1    =F1  =   .732*F3   +-.387*F2   + .561 D1
  F3    =F3  =   .269*F4   + .963 D3
```

The syntax file for comparing the two groups.

File Name = LSQMODFM.EQS

```
/TITLE
MODEL FOR FEMALES
/SPECIFICATIONS
 !DATA='C:\EQSW\LSQMATF.ESS'; VARIABLES= 13; CASES=  208;
 VARIABLES= 13; CASES=  208; GROUPS=2;
 METHODS=ML;
 MATRIX=COVARIANCE;
/LABELS
V1=ENJOY; V2=FGOOD; V3=WORTH; V4=TENSE; V5=SHY;
V6=FITIN; V7=OUTGOING; V8=COPERTIV; V9=ARRANGE; V10=INCLUDED;
V11=EXCITING; V12=FRSUPP; V13=FRLEIS;
/LMTEST
/EQUATIONS
V1 =  + *F1  + E1;
V2 =  + *F1  + E2;
V3 =  + F1   + E3;
V4 =  + *F2  + E4;
v5 = *f2 + e5;
V7 =  + *F3  + E7;
V11 =  + F3  + E11;
V12 = *F4 + E12;
```

V13 = + *F4 + E13;

F1 = + *F2 + *F3 + D1;

F3 = + *F4 + D3;

/VARIANCES

F2 = 1.00;

F4 = 1.00;

E1 = *;

E2 = *;

E3 = *;

E4 = *;

e5=*;

E7 = *;

E11 = *;

E12 = *;

E13 = *;

D1 = *;

D3 = *;

/MATRIX

3.877						
1.759	2.853					
1.301	2.060	3.319				
-1.550	-1.099	-1.118	3.660			
-0.342	-0.284	-0.196	0.474	0.419		
0.951	1.460	1.462	-0.871	-0.179	3.005	
0.841	1.408	1.710	-0.345	-0.286	1.355	4.276
0.717	1.047	0.895	-0.527	-0.185	0.916	1.024
1.637						
0.167	1.097	1.498	-0.145	-0.146	1.038	1.041
0.745	4.464					
0.744	0.907	0.865	-0.404	-0.209	1.050	1.198
0.833	1.436	3.186				
0.943	1.213	1.619	-0.563	-0.118	1.335	1.374
0.712	1.855	1.234	4.428			
0.789	0.972	1.038	-0.050	-0.174	1.059	1.100
0.707	1.245	1.602	0.634	5.496		
1.072	0.688	0.247	-0.171	-0.097	0.578	0.292
0.066	0.100	0.624	0.035	1.929	3.986	

/END

/TITLE

MODEL FOR MALES

/SPECIFICATIONS

!DATA='C:\EQSW\LSQMATM.ESS'; VARIABLES= 13; CASES= 178;

VARIABLES= 13; CASES= 178; GROUPS=2;

METHODS=ML;

```
   MATRIX=COVARIANCE;
/LABELS
V1=ENJOY; V2=FGOOD; V3=WORTH; V4=TENSE; V5=SHY;
V6=FITIN; V7=OUTGOING; V8=COPERTIV; V9=ARRANGE; V10=INCLUDED;
V11=EXCITING; V12=FRSUPP; V13=FRLEIS;
/TEC
  ITR=100;
/LMTEST
/EQUATIONS
V1 =  + *F1  + E1;
V2 =  + *F1  + E2;
V3 =  + F1  + E3;
V4=*F2+E4;
V5 =  + *F2  + E5;
V7 =  + *F3  + E7;
V11 =  + F3  + E11;
V12 =  + *F4  + E12;
V13 =  + *F4  + E13;
F1 =  + *F2  + *F3  + D1;
F3 =  + *F4  + D3;
/VARIANCES
F2 = 1.00;
F4 = 1.00;
E1 = *;
E2 = *;
E3 = *;
E4=*;
E5 = *;
E7 = *;
E11 = *;
E12 = *;
E13 = *;
D1 = *;
D3 = *;
/MATRIX
    3.985
    1.578    3.079
    1.408    2.180    3.331
   -1.216   -0.861   -0.663    3.237
   -0.137   -0.270   -0.304    0.214    0.401
    0.342    0.634    0.863   -0.390   -0.222    3.554
    0.804    1.206    1.390   -0.377   -0.348    1.084    3.684
    0.537    0.848    0.693   -0.210   -0.177    0.628    0.528
    2.041
```

-0.260	0.690	1.033	0.345	-0.274	0.691	1.046
0.654	3.869					
0.341	0.958	0.875	0.333	-0.173	0.928	1.070
0.659	1.347	3.508				
1.107	1.442	1.652	-0.692	-0.289	1.079	1.367
0.430	1.080	1.495	3.233			
0.080	0.435	0.313	-0.162	-0.181	1.117	0.490
0.413	0.367	0.442	0.601	4.257		
0.671	0.274	0.262	-0.254	0.040	0.901	0.373
0.075	0.030	0.563	0.788	2.461	4.339	

```
/CON
(1,V1,F1)=(2,V1,F1);
(1,V2,F1)=(2,V2,F1);
(1,V4,F2)=(2,V4,F2);
(1,V5,F2)=(2,V5,F2);
(1,V7,F3)=(2,V7,F3);
(1,V12,F4)=(2,V12,F4);
(1,V13,F4)=(2,V13,F4);
(1,F1,F2)=(2,F1,F2);
(1,F1,F3)=(2,F1,F3);
(1,F3,F4)=(2,F3,F4);
/END
```

Goodness of fit, standardized solution, and constriant tests of significance.

STANDARDIZED SOLUTION:


```
ENJOY   =V1  =  .531*F1   + .848 E1
FGOOD   =V2  =  .829*F1   + .560 E2
WORTH   =V3  =  .766 F1   + .642 E3
TENSE   =V4  =  .789*F2   + .614 E4
  SHY   =V5  =  .395*F2   + .919 E5
OUTGOING=V7  =  .563*F3   + .826 E7
EXCITING=V11 =  .549 F3   + .836 E11
FRSUPP  =V12 =  .774*F4   + .633 E12
FRLEIS  =V13 =  .588*F4   + .809 E13
   F1   =F1  =  .806*F3   +-.415*F2   + .421 D1
   F3   =F3  =  .325*F4   + .946 D3
```


STANDARDIZED SOLUTION:

```
ENJOY    =V1  =   .549*F1    + .836 E1
FGOOD    =V2  =   .833*F1    + .553 E2
WORTH    =V3  =   .806 F1    + .592 E3
TENSE    =V4  =   .764*F2    + .646 E4
 SHY     =V5  =   .382*F2    + .924 E5
OUTGOING=V7  =    .602*F3    + .799 E7
EXCITING=V11 =    .677 F3    + .736 E11
FRSUPP   =V12 =   .895*F4    + .446 E12
FRLEIS   =V13 =   .597*F4    + .802 E13
  F1    =F1  =   .759*F3    +-.379*F2    + .530 D1
  F3    =F3  =   .315*F4    + .949 D3
```

GOODNESS OF FIT SUMMARY

INDEPENDENCE MODEL CHI-SQUARE =   865.593 ON   72 DEGREES OF FREEDOM

INDEPENDENCE AIC =   721.59332   INDEPENDENCE CAIC =   364.77303
      MODEL AIC =   19.69636   MODEL CAIC = -267.74221

CHI-SQUARE =   135.696 BASED ON   58 DEGREES OF FREEDOM
PROBABILITY VALUE FOR THE CHI-SQUARE STATISTIC IS LESS THAN 0.001

BENTLER-BONETT NORMED   FIT INDEX=   0.843
BENTLER-BONETT NONNORMED FIT INDEX=   0.878
COMPARATIVE FIT INDEX   =   0.902

LAGRANGE MULTIPLIER TEST (FOR RELEASING CONSTRAINTS)

CONSTRAINTS TO BE RELEASED ARE:

        CONSTRAINTS FROM GROUP 2

```
        CONSTR:   1   (1,V1,F1)-(2,V1,F1)=0;      0.542        0.462

        CONSTR:   2   (1,V2,F1)-(2,V2,F1)=0;      0.139        0.709

        CONSTR:   3   (1,V4,F2)-(2,V4,F2)=0;      5.077        0.024

        CONSTR:   4   (1,V5,F2)-(2,V5,F2)=0;      2.337        0.126

        CONSTR:   5   (1,V7,F3)-(2,V7,F3)=0;      0.832        0.362

        CONSTR:   6   (1,V12,F4)-(2,V12,F4)       0.008      0.929=0;

        CONSTR:   7   (1,V13,F4)-(2,V13,F4)       2.685      0.101=0;

        CONSTR:   8   (1,F1,F2)-(2,F1,F2)=0;      1.328        0.249

        CONSTR:   9   (1,F1,F3)-(2,F1,F3)=0;      1.186        0.276

        CONSTR:  10   (1,F3,F4)-(2,F3,F4)=0;      2.490        0.115


            UNIVARIATE TEST STATISTICS:


    NO    CONSTRAINT    CHI-SQUARE   PROBABILITY
    --    -----------   ----------   -----------


    1    CONSTR:   1      0.542          0.462

    2    CONSTR:   2      0.139          0.709

    3    CONSTR:   3      5.077          0.024

    4    CONSTR:   4      2.337          0.126

    5    CONSTR:   5      0.832          0.362

    6    CONSTR:   6      0.008          0.929

    7    CONSTR:   7      2.685          0.101

    8    CONSTR:   8      1.328          0.249

    9    CONSTR:   9      1.186          0.276

   10    CONSTR:  10      2.490          0.115
```

```
         CUMULATIVE MULTIVARIATE STATISTICS          UNIVARIATE INCREMENT
         ----------------------------------          --------------------


 STEP  PARAMETER   CHI-SQUARE  D.F.  PROBABILITY     CHI-SQUARE  PROBABILITY
 ----  ----------  ----------  ----  -----------     ----------  -----------


   1  CONSTR:   3    5.077      1      0.024           5.077       0.024

   2  CONSTR:   7    7.762      2      0.021           2.685       0.101

   3  CONSTR:   6    9.878      3      0.020           2.117       0.146

   4  CONSTR:  10   10.724      4      0.030           0.845       0.358

   5  CONSTR:   5   11.272      5      0.046           0.548       0.459

   6  CONSTR:   9   12.702      6      0.048           1.430       0.232

   7  CONSTR:   4   13.203      7      0.067           0.501       0.479

   8  CONSTR:   1   13.571      8      0.094           0.369       0.544
```

```
 9  CONSTR:   8    13.765    9    0.131        0.193      0.660
10  CONSTR:   2    13.765   10    0.184        0.001      0.981
```