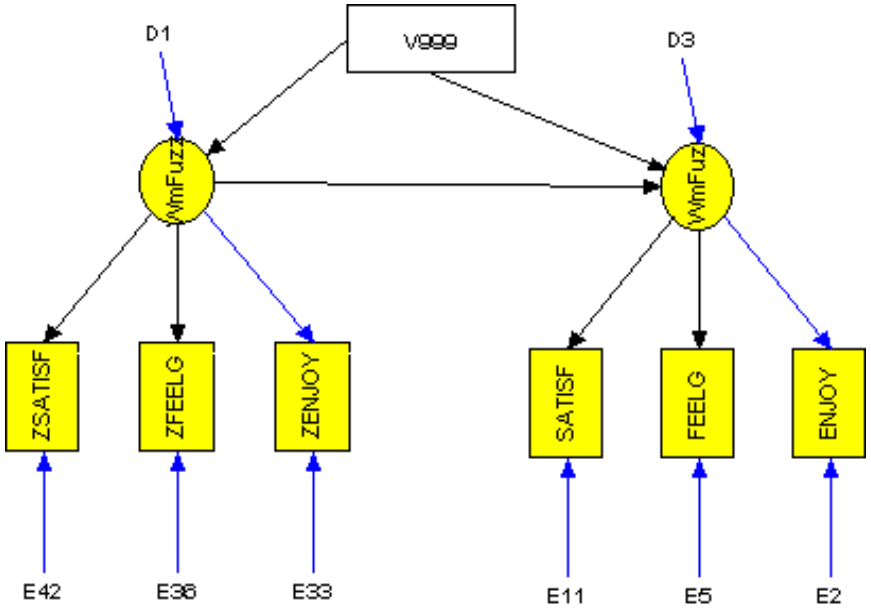
Structural Equation Modeling

Chapter 11

Comparing Means

Merle Canfield

This chapter demonstrates a method for comparing the means of two factors in a pre/post study.



The V999 "measured" variable of EQS has characteristics such the regression coefficient between and other variables result in either the mean of the second variable or the intercept of the second variable. When it is significant in a previously dependent variable (such as in factor F3) it indicates that after the other variance is removed the means between the two factors are different.

The above diagram is created in the usual manner except for the V999 variable. It is created by clicking on the "V" from the "toolbox" moving the + to the area of the diagram desired and clicking at the spot to anchor the variable. The double on the box to open the window and renumber the variable V999 and rename the variable V999.

Build the syntax file in the usual manner:

Click Build_EQS

Click on Title/Specifications

At this point a command ANAL=MOM; is placed in the SPE paragraph of the syntax file.

Click on Build_EQS

Click on Run EQS/386

The syntax file follows:

```
/TITLE

/SPECIFICATIONS
 DATA='D:\EQSW\PASKVCT.ESS'; VARIABLES= 60; CASES=  109;
 METHODS=ML;anal=mom;
 MATRIX=RAW;
/LABELS
V1=ENJOY; V2=FEAR; V3=SAD; V4=FEELG; V5=ANGRY;
V6=CONFUS; V7=WORTH; V8=TENSE; V9=USELES; V10=SATISF;
V11=TOGETH; V12=BILLS; V13=TALK; V14=CONFL; V15=ALCO;
V16=DRUGS; V17=SUPPRT; V18=EMPLOY; V19=GOODJ; V20=LIKE;
V21=INTERF; V22=INCOME; V23=HEALTH; V24=DSTRS; V25=QUALY;
V26=RELAT; V27=EMPLY; V28=SUBAB; V29=BASIC; V30=SALRY;
V31=ZENJOY; V32=ZFEAR; V33=ZSAD; V34=ZFEELG; V35=ZANGRY;
V36=ZCONFUS; V37=ZWORTH; V38=ZTENSE; V39=ZUSELES; V40=ZSATISF;
V41=ZTOGETH; V42=ZBILLS; V43=ZTALK; V44=ZCONFL; V45=ZALCO;
V46=ZDRUGS; V47=ZSUPPRT; V48=ZEMPLOY; V49=ZGOODJ; V50=ZLIKE;
V51=ZINTERF; V52=ZINCOME; V53=ZHEALTH; V54=ZDSTRS; V55=ZQUALY;
V56=ZRELAT; V57=ZEMPLY; V58=ZSUBAB; V59=ZBASIC; V60=ZSALRY;
V56=ZRELAT; V57=ZEMPLY; V58=ZSUBAB; V59=ZBASIC; V60=ZSALRY;
/EQUATIONS
V1 =  + 1.0F2  + E1;
V4 =  + *F2  + E4;
V10 =  + *F2  + E10;
V31 =  + 1.0F1  + E31;
V34 =  + *F1  + E34;
V40 =  + *F1  + E40;
F1 =  + *V999 + D1;
F2 =  + *F1  + *V999 + D2;
/VARIANCES
V999 = 1.00;
E1 = *;
E4 = *;
E10 = *;
E31 = *;
E34 = *;
E40 = *;
D1 = *;
D2 = *;
/COVARIANCES
/PRINT
  effect=yes; covariance=yes;
```

```
 digit=3;
 linesize =80;
/OUTPUT
 parameters;
 standard errors;
 listing;
 data='EQSOUT&.ETS';
/END
```

The output file follows:

```
 MATRIX CONTAINS SPECIAL VARIABLE V999, THE UNIT CONSTANT
 COVARIANCE MATRIX IS IN UPPER TRIANGLE; MEANS ARE IN BOTTOM ROW OF MATRIX
 COVARIANCE/MEAN MATRIX TO BE ANALYZED:
    6 VARIABLES (SELECTED FROM  60 VARIABLES), BASED ON   109 CASES.


                  ENJOY      FEELG      SATISF     ZENJOY     ZFEELG
                   V  1       V  4       V 10       V 31       V 34
    ENJOY     V  1       5.213
    FEELG     V  4       2.797      4.939
    SATISF    V 10       3.144      3.341      6.252
    ZENJOY    V 31       0.776      0.143     -0.139      4.812
    ZFEELG    V 34       0.837      0.748      0.657      2.534      6.206
    ZSATISF   V 40       0.730      0.120      0.637      1.748      2.558
       V999   V999       5.009      4.927      4.477      4.174      3.596


                  ZSATISF       V999
                   V 40        V999
    ZSATISF   V 40       5.847
       V999   V999       4.119      1.000        [The V999 row contains the mean estimates]


 PARAMETER ESTIMATES APPEAR IN ORDER,
 NO SPECIAL PROBLEMS WERE ENCOUNTERED DURING OPTIMIZATION.


 MODEL COVARIANCE MATRIX FOR MEASURED AND LATENT VARIABLES


                  ENJOY      FEELG      SATISF     ZENJOY     ZFEELG
                   V  1       V  4       V 10       V 31       V 34
    ENJOY     V  1       5.542
```

```
   FEELG     V  4       3.167       5.050
   SATISF    V 10       2.927       2.891       5.663
   ZENJOY    V 31       0.498       0.491       0.454       5.059
   ZFEELG    V 34       0.442       0.436       0.403       2.113       5.592
   ZSATISF   V 40       0.490       0.484       0.448       2.345       2.082
     V999  V999         4.976       4.915       4.542       4.145       3.681
     F1     F  1        0.498       0.491       0.454       2.379       2.113
     F2     F  2        3.207       3.167       2.927       0.498       0.442


                  ZSATISF       V999        F1          F2
                   V 40         V999        F  1        F  2
   ZSATISF   V 40       6.135
     V999  V999         4.084       1.000
     F1     F  1        2.345       4.145       2.379                [Estimates of the means of
     F2     F  2        0.490       4.976       0.498       3.207    the factors.]
```

GOODNESS OF FIT SUMMARY

INDEPENDENCE MODEL CHI-SQUARE = 159.884 ON 15 DEGREES OF FREEDOM

INDEPENDENCE AIC = 129.88396 INDEPENDENCE CAIC = 74.51374
MODEL AIC = -8.68164 MODEL CAIC = -52.97781

CHI-SQUARE = 15.318 BASED ON 12 DEGREES OF FREEDOM
PROBABILITY VALUE FOR THE CHI-SQUARE STATISTIC IS 0.22449
THE NORMAL THEORY RLS CHI-SQUARE FOR THIS ML SOLUTION IS 14.419.

BENTLER-BONETT NORMED FIT INDEX= 0.904
BENTLER-BONETT NONNORMED FIT INDEX= 0.971
COMPARATIVE FIT INDEX (CFI) = 0.977

MEASUREMENT EQUATIONS WITH STANDARD ERRORS AND TEST STATISTICS

```
ENJOY   =V1  =   1.000 F2    + 1.000 E1


FEELG   =V4  =    .988*F2    + 1.000 E4
                   .038
                 25.686
```

```
SATISF  =V10 =    .913*F2    + 1.000 E10
                  .041
                 22.091

ZENJOY  =V31 =   1.000 F1    + 1.000 E31



ZFEELG  =V34 =    .888*F1    + 1.000 E34
                  .055
                 16.278

ZSATISF =V40 =    .985*F1    + 1.000 E40
                  .057
                 17.149

 CONSTRUCT EQUATIONS WITH STANDARD ERRORS AND TEST STATISTICS


  F1   =F1  =   4.145*V999  + 1.000 D1
                .215
               19.276

  F2   =F2  =    .209*F1    + 4.110*V999  + 1.000 D2
                .153          .670
               1.363         6.135

 DECOMPOSITION OF EFFECTS WITH NONSTANDARDIZED VALUES

 PARAMETER TOTAL EFFECTS
 -----------------------

ENJOY   =V1  =    .209 F1    + 1.000 F2    + 4.976 V999  + 1.000 E1
                  .209 D1    + 1.000 D2

FEELG   =V4  =    .207 F1    +  .988*F2    + 4.915 V999  + 1.000 E4
                  .207 D1    +  .988 D2

SATISF  =V10 =    .191 F1    +  .913*F2    + 4.542 V999  + 1.000 E10
                  .191 D1    +  .913 D2
```

[When the t-statistic of the V999 variable is significant The y-intercept, and therefor The means are different.]

```
ZENJOY  =V31 =   1.000 F1    + 4.145 V999  + 1.000 E31   + 1.000 D1

ZFEELG  =V34 =    .888*F1    + 3.681 V999  + 1.000 E34   +  .888 D1

ZSATISF =V40 =    .985*F1    + 4.084 V999  + 1.000 E40   +  .985 D1

  F1   =F1  =   4.145*V999  + 1.000 D1

  F2   =F2  =    .209*F1    + 4.976*V999  +  .209 D1    + 1.000 D2


 DECOMPOSITION OF EFFECTS WITH NONSTANDARDIZED VALUES

 PARAMETER INDIRECT EFFECTS
 --------------------------

ENJOY   =V1  =    .209 F1    + 4.976 V999  +  .209 D1    + 1.000 D2
               .153          .671
              1.363         7.419


FEELG   =V4  =    .207 F1    + 4.915 V999  +  .207 D1    +  .988 D2
               .151          .665          .008          .038
              1.364         7.387        25.686        25.686


SATISF  =V10 =    .191 F1    + 4.542 V999  +  .191 D1    +  .913 D2
               .140          .624          .009          .041
              1.363         7.278        22.091        22.091


ZENJOY  =V31 =   4.145 V999  + 1.000 D1
               .215
             19.276

ZFEELG  =V34 =   3.681 V999  +  .888 D1
               .224          .055
             16.419        16.278

ZSATISF =V40 =   4.084 V999  +  .985 D1
               .236          .057
             17.339        17.149

  F2   =F2  =    .867*V999  +  .209 D1
```

.704 .154
1.231 1.362

DECOMPOSITION OF EFFECTS WITH STANDARDIZED VALUES

PARAMETER TOTAL EFFECTS

ENJOY =V1 = .137 F1 + .761 F2 + .649 E1 + .137 D1
.748 D2

FEELG =V4 = .142 F1 + .787*F2 + .617 E4 + .142 D1
.774 D2

SATISF =V10 = .124 F1 + .687*F2 + .727 E10 + .124 D1
.676 D2

ZENJOY =V31 = .686 F1 + .728 E31 + .686 D1

ZFEELG =V34 = .579*F1 + .815 E34 + .579 D1

ZSATISF =V40 = .614*F1 + .790 E40 + .614 D1

F1 =F1 = 1.000 D1

F2 =F2 = .180*F1 + .180 D1 + .984 D2

DECOMPOSITION OF EFFECTS WITH STANDARDIZED VALUES

PARAMETER INDIRECT EFFECTS

ENJOY =V1 = .137 F1 + .137 D1 + .748 D2

FEELG =V4 = .142 F1 + .142 D1 + .774 D2

SATISF =V10 = .124 F1 + .124 D1 + .676 D2

ZENJOY =V31 = .686 D1

ZFEELG =V34 = .579 D1

ZSATISF =V40 = .614 D1

F2 =F2 = .180 D1

STANDARDIZED SOLUTION:

ENJOY =V1 = .761 F2 + .649 E1
FEELG =V4 = .787*F2 + .617 E4
SATISF =V10 = .687*F2 + .727 E10
ZENJOY =V31 = .686 F1 + .728 E31
ZFEELG =V34 = .579*F1 + .815 E34
ZSATISF =V40 = .614*F1 + .790 E40
F1 =F1 = .000*V999 +1.000 D1
F2 =F2 = .180*F1 + .000*V999 + .984 D2