**Example 2: Examining BP and WP Effects of Within-Person Fluctuation**
***complete data, syntax, and output available electronically for SAS, SPSS, or STATA (2a) and Mplus (2b)***

These data were simulated loosely based on real data reported in the citation below. The daily diary study followed persons with Type II diabetes for 21 consecutive days to examine within-person relationships between mood, stress, and morning glucose (an index of how well-controlled the diabetes is). Here we will use univariate multilevel models to examine between-person and within-person relationships between daily negative mood and glucose the next morning (which was log-transformed given skewness) and how these relationships are moderated by sex. For comparability with Mplus, all models were estimated using ML. No time effects were detected in the original data, and so "time" is not included as a predictor in these models.

Skaff, M., Mullan J., Fisher, L., Almeida, D., **Hoffman, L.**, Masharani, U., & Mohr, D. (2009). Daily negative mood affects fasting glucose in Type 2 Diabetes. *Health Psychology, 28*(3), 265-272. PMC2810194.

## SAS Data Manipulation (used in Example 2a):

```
* SAS code to read data into work library and center predictors;
DATA work.Example2; SET example.Example2;
* Level-2 effect of Negative Mood (mean=0, SD=1);
  PMnm0 = PMnegmood - 0;  LABEL PMnm0= "PMnm0: Person Mean Negative Mood (0=0)";
* Level-1 effect to use with PERSON-MEAN-CENTERING;
  WPnm = negmood - PMnegmood; LABEL wpnm= "WPnm: Within-Person Negative Mood (0=PM)";
* Level-1 effect to use with GRAND-MEAN-CENTERING;
  TVnm0 = negmood - 0; LABEL TVnm0= "TVnm0: Time-Varying Negative Mood (0=0)";
* Gender already exists;
  LABEL sexMW = "Participant Sex (0=M, 1=W)";
RUN;
```

## SPSS Data Manipulation (used in Example 2a):

```
* SPSS code to import data and center predictors, gender already exists.
GET FILE = "example/Example2.sav".
DATASET NAME Example2 WINDOW=FRONT.
COMPUTE PMnm0 = PMnegmood - 0.
COMPUTE WPnm  = negmood - PMnegmood.
COMPUTE TVnm0 = negmood - 0.
VARIABLE LABELS
  PMnm0 "PMnm0: Person Mean Negative Mood (0=0)"
  WPnm  "WPnm: Within-Person Negative Mood (0=PM)"
  TVnm0 "TVnm0: Time-Varying Negative Mood (0=0)"
  sexMW "sexMW: Participant Sex (0=M, 1=W)".
EXECUTE.
```

## STATA Data Manipulation (used in Example 2a):

```
* STATA code to center predictors
* level-2 effect of negative mood
gen PMnm0 = PMnegmood - 0
label variable PMnm0 "PMnm0: Person Mean Negative Mood (0=0)"
* level-1 effect to use with PERSON-MEAN-CENTERING
gen WPnm = negmood - PMnegmood
label variable WPnm "WPnm: Within-Person Negative Mood (0=PM)"
* level-1 effect to use with GRAND-MEAN-CENTERING
gen TVnm0 = negmood - 0
label variable TVnm0 "TVnm0: Time-Varying Negative Mood (0=0)"
* gender already exists
label variable sexMW "SexMW: Participant Sex (0=M, 1=W)"
```

Note: I am not using the new "small" options available in STATA v 14+ that allow denominator DF options because Satterthwaite and KR are only available when using REML. (The PilesOfVariance.com website for example syntax on how to use these options.) As a result, STATA's output should exactly match that of Mplus (with no denominator DF).

# PART 1: VARIANCE DECOMPOSITION

## Model 1a. Empty Model for LN Morning Glucose (Daily Outcome)

```
TITLE1 "SAS Model 1a: Empty Model for Daily Glucose Outcome";
PROC MIXED DATA=work.Example2 COVTEST NOCLPRINT NOITPRINT NAMELEN=100 IC METHOD=ML;
     CLASS ID day;
     MODEL lglucAM = / SOLUTION DDFM=Satterthwaite;
     RANDOM INTERCEPT / VCORR SUBJECT=ID TYPE=UN;
     REPEATED day / SUBJECT=ID TYPE=VC;
     ODS OUTPUT CovParms=CovEmpty InfoCrit=FitEmpty; * Save covparms, fit;
RUN; TITLE1;
```

Level 1: $\text{Glucose}_{ti} = \beta_{0i} + e_{ti}$
Level 2: $\beta_{0i} = \gamma_{00} + U_{0i}$

```
ECHO "SPSS Model 1a: Empty Model for Daily Glucose Outcome".
MIXED lGlucAM BY ID day
      /METHOD = ML
      /PRINT  = SOLUTION TESTCOV
      /FIXED  =
      /RANDOM = INTERCEPT | SUBJECT(ID) COVTYPE(UN)
      /REPEATED = day | SUBJECT(ID) COVTYPE(ID).

* STATA Model 1a: Empty Model for Daily Glucose Outcome
mixed lglucAM  , || id: , variance ml covariance(un) residuals(independent,t(day)),
     estat icc,               // get ICC
     estimates store empty     // save LL for LRT
```

### SAS output:

Covariance Parameter Estimates

| Cov Parm | Subject | Estimate | Standard Error | Z Value | Pr > Z | |
|---|---|---|---|---|---|---|
| UN(1,1) | ID | 0.06654 | 0.006690 | 9.95 | <.0001 | Random intercept variance |
| day | ID | 0.03029 | 0.000683 | 44.35 | <.0001 | Residual variance |

Null Model Likelihood Ratio Test

| DF | Chi-Square | Pr > ChiSq |
|---|---|---|
| 1 | 4024.09 | <.0001 |

Calculate the ICC for the glucose outcome: $\text{ICC} = \frac{.06654}{.06654 + .03029} = .69$
This LR test tells us that the random intercept variance is significantly greater than 0, and thus so is the ICC.

Information Criteria

| Neg2LogLike | Parms | AIC | AICC | HQIC | BIC | CAIC |
|---|---|---|---|---|---|---|
| -1941.5 | 3 | -1935.5 | -1935.5 | -1931.4 | -1925.5 | -1922.5 |

## Model 1b. Empty Model for Negative Mood (Daily Predictor)

```
TITLE1 "SAS Model 1b: Empty Model for Daily Negative Mood Predictor";
PROC MIXED DATA=work.Example2 COVTEST NOCLPRINT NOITPRINT NAMELEN=100 IC METHOD=ML;
     CLASS ID day;
     MODEL negmood = / SOLUTION DDFM=Satterthwaite;
     RANDOM INTERCEPT / VCORR SUBJECT=ID TYPE=UN;
     REPEATED day / SUBJECT=ID TYPE=VC;
RUN; TITLE1;
```

Level 1: $\text{Mood}_{ti} = \beta_{0i} + e_{ti}$
Level 2: $\beta_{0i} = \gamma_{00} + U_{0i}$

```
ECHO "SPSS Model 1b: Empty Model for Daily Negative Mood Predictor".
MIXED negmood BY ID day
      /METHOD = ML
      /PRINT  = SOLUTION TESTCOV
      /FIXED  =
      /RANDOM = INTERCEPT | SUBJECT(ID) COVTYPE(UN)
      /REPEATED = day | SUBJECT(ID) COVTYPE(ID).

* STATA Model 1b: Empty Model for Daily Negative Mood Predictors
mixed negmood  , || id: , variance ml covariance(un) residuals(independent,t(day)),
      estat icc          // get ICC
```

## SAS output:

Estimated V Correlation Matrix for ID 1

| Row | Col1 | Col2 | Col3 | Col4 | Col5 | Col6 | Col7 | Col8 | Col9 | Col10 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.0000 | 0.3895 | 0.3895 | 0.3895 | 0.3895 | 0.3895 | 0.3895 | 0.3895 | 0.3895 | 0.3895 |
| 2 | 0.3895 | 1.0000 | 0.3895 | 0.3895 | 0.3895 | 0.3895 | 0.3895 | 0.3895 | 0.3895 | 0.3895 |
| 3 | 0.3895 | 0.3895 | 1.0000 | 0.3895 | 0.3895 | 0.3895 | 0.3895 | 0.3895 | 0.3895 | 0.3895 |

.....

Covariance Parameter Estimates

| Cov Parm | Subject | Estimate | Standard Error | Z Value | Pr > Z |
|---|---|---|---|---|---|
| UN(1,1) | ID | 0.3355 | 0.03557 | 9.43 | <.0001 |
| day | ID | 0.5258 | 0.01186 | 44.35 | <.0001 |

Null Model Likelihood Ratio Test

| DF | Chi-Square | Pr > ChiSq |
|---|---|---|
| 1 | 1500.40 | <.0001 |

Calculate the ICC for the mood predictor:

$$\text{ICC} = \frac{.3355}{.3355 + .5258} = .39$$

This LR test tells us that the random intercept variance is significantly greater than 0, and thus so is the ICC.

## PART 2: PERSON-MEAN-CENTERING OF NEGATIVE MOOD TO PREDICT GLUCOSE

### Model 2a. Fixed Effects of Negative Mood using Person-Mean-Centering (PMC)

Level 1: $\text{Glucose}_{ti} = \beta_{0i} + \beta_{1i}\left(\text{Mood}_{ti} - \overline{\text{Mood}}_i\right) + e_{ti}$

Level 2: Intercept: $\beta_{0i} = \gamma_{00} + \gamma_{01}\left(\overline{\text{Mood}}_i - 0\right) + U_{0i}$

Within-Person Mood: $\beta_{1i} = \gamma_{10}$

```
TITLE1 "SAS Model 2a: Fixed Effects of Negative Mood using PMC";
PROC MIXED DATA=work.Example2 COVTEST NOCLPRINT NOITPRINT NAMELEN=100 IC METHOD=ML;
     CLASS ID day;
     MODEL lglucAM = WPnm PMnm0 / SOLUTION DDFM=Satterthwaite OUTPM=PredMood;
     RANDOM INTERCEPT / SUBJECT=ID TYPE=UN;
     REPEATED day / SUBJECT=ID TYPE=VC;
     ODS OUTPUT CovParms=CovMood InfoCrit=FitMood; * Save covparms, fit;
     ESTIMATE "Within-Person Mood Effect"    WPnm  1;
     ESTIMATE "Between-Person Mood Effect"   PMnm0 1;
     ESTIMATE "Contextual Mood Effect"       PMnm0 1 WPnm -1;
RUN; TITLE1;

ECHO "SPSS Model 2a: Fixed Effects of Negative Mood using PMC".
MIXED lglucAM BY ID day WITH WPnm PMnm0
      /METHOD = ML
      /PRINT  = SOLUTION TESTCOV
      /FIXED  = WPnm PMnm0
      /RANDOM = INTERCEPT | SUBJECT(ID) COVTYPE(UN)
      /REPEATED = day | SUBJECT(ID) COVTYPE(ID)
      /SAVE = FIXPRED (predmood)
      /TEST = "Within-Person Mood Effect"    WPnm  1
      /TEST = "Between-Person Mood Effect"   PMnm0 1
      /TEST = "Contextual Mood Effect"       PMnm0 1 WPnm -1.
CORRELATIONS lglucAM predmood.

* STATA Model 2a: Fixed Effects of Negative Mood using PMC
mixed lglucAM c.WPnm c.PMnm0, || id: ,      ///
        variance ml covariance(un) residuals(independent,t(day)),
     estat ic, n(207),
     predict predmood,          // save fixed-effect predicted outcomes
     estimates store FixWP,     // save LL for LRT
     lrtest FixWP empty,        // LRT against empty model
```

```
     lincom 1*c.WPnm                // within-person mood effect
     lincom 1*c.PMnm0               // between-person mood effect
     lincom 1*c.PMnm0 - 1*c.WPnm    // contextual mood effect
corr lglucAM predmood
```

## SAS output:

```
                Covariance Parameter Estimates
                                  Standard         Z
Cov Parm    Subject    Estimate       Error     Value        Pr Z
UN(1,1)     ID         0.06435    0.006474      9.94      <.0001
Day         ID         0.03022    0.000682     44.35      <.0001

                          Information Criteria
Neg2LogLike    Parms        AIC       AICC       HQIC        BIC       CAIC
    -1956.5        5    -1946.5    -1946.5    -1939.8    -1929.9    -1924.9

                   Solution for Fixed Effects
                         Standard
Effect       Estimate       Error      DF    t Value    Pr > |t|
Intercept      4.9302     0.01845     207     267.20      <.0001
WPnm          0.01097    0.003821    3941       2.87      0.0041
PMnm0         0.08040     0.03046     207       2.64      0.0089

                               Estimates
                                   Standard
Label                     Estimate       Error      DF    t Value    Pr > |t|
Within-Person Effect       0.01097    0.003821    3941       2.87      0.0041
Between-Person Effect      0.08040     0.03046     207       2.64      0.0089
Contextual Effect          0.06942     0.03070     213       2.26      0.0247
```

What does the level-1 effect (WPnm) represent in this model?
*The level-1 effect is the within-person effect of negative mood. For every unit relative increase in your own negative mood that day, that day's glucose goes up by .01097 (WP relation among daily levels).*

What does the level-2 effect (PMnm0) represent in this model?
*The level-2 effect is the between-person effect of negative mood. For every unit increase in your mean negative mood, mean glucose is higher by .0804 (BP relation among mean levels).*

What does the "contextual effect" represent?
*It is the test of the difference in the between-person and within-person effects: the between-person effect is significantly greater than the within-person effect by .07 (so convergence was not obtained).*

```
* Calculate PseudoR2 relative to empty model;
%PseudoR2(NCov=2, CovFewer=CovEmpty, CovMore=CovMood);

PsuedoR2 (% Reduction) for CovEmpty vs. CovMood

  Name      CovParm    Subject    Estimate      StdErr    ZValue     ProbZ    PseudoR2
CovEmpty    UN(1,1)      ID        0.06654    0.006690      9.95    <.0001      .
CovEmpty    day          ID        0.03029    0.000683     44.35    <.0001      .
CovMood     UN(1,1)      ID        0.06435    0.006474      9.94    <.0001    0.032967
CovMood     day          ID        0.03022    0.000682     44.35    <.0001    0.002105
```

Which variance did the level-1 effect of WPnm account for? *0.2% of the residual variance*

Which variance did the level-2 effect of PMnm0 account for? *3.3% of the random intercept variance*

```
* Calculate Total R2 (nothing to compare it to yet);
PROC CORR DATA=PredMood; VAR lGlucAM pred; RUN;

Pearson Correlation Coefficients, N = 4140
       Prob > |r| under H0: Rho=0
                    lglucAM          Pred
lglucAM             1.00000       0.15269
                                   <.0001
```

**Total** variance accounted for in glucose by the effects of negative mood: $r$ = .15269, $R^2$ = .023.

What is the total reduction in glucose variance so far? *2.3% of the overall variance*

```
* Calculate difference in model fit relative to empty model;
%FitTest(FitFewer=FitEmpty, FitMore=FitMood);

Likelihood Ratio Test for FitEmpty vs. FitMood

            Neg2Log
  Name       Like      Parms        AIC        BIC     DevDiff    DFdiff        Pvalue
FitEmpty    -1941.5       3     -1935.5    -1925.5       .          .       .
FitMood     -1956.5       5     -1946.5    -1929.9    15.0818       2      .000530910
```

Is this total reduction in variance significant? *Yes, according to the df=2 LRT against the empty means model.*

## Model 2b. Random Effect of WP Negative Mood under PMC

Level 1: $\text{Glucose}_{ti} = \beta_{0i} + \beta_{1i}\left(\text{Mood}_{ti} - \overline{\text{Mood}}_i\right) + e_{ti}$

Level 2: Intercept: $\beta_{0i} = \gamma_{00} + \gamma_{01}\left(\overline{\text{Mood}}_i - 0\right) + U_{0i}$

Within-Person Mood: $\beta_{1i} = \gamma_{10} + U_{1i}$

```
TITLE1 "SAS Model 2b: Random Effect of WP Negative Mood using PMC";
PROC MIXED DATA=work.Example2 COVTEST NOCLPRINT NOITPRINT NAMELEN=100 IC METHOD=ML;
     CLASS ID day;
     MODEL lglucAM = WPnm PMnm0 / SOLUTION DDFM=Satterthwaite;
     RANDOM INTERCEPT WPnm / SUBJECT=ID TYPE=UN;
     REPEATED day / SUBJECT=ID TYPE=VC;
     ODS OUTPUT InfoCrit=FitRandMood; * Save fit;
     ESTIMATE "Within-Person Mood Effect"   WPnm  1;
     ESTIMATE "Between-Person Mood Effect"  PMnm0 1;
     ESTIMATE "Contextual Mood Effect"      PMnm0 1 WPnm -1;
RUN; TITLE1;

ECHO "SPSS Model 2b: Random Effect of WP Negative Mood using PMC".
MIXED lglucAM BY ID day WITH WPnm PMnm0
      /METHOD = ML
      /PRINT  = SOLUTION TESTCOV
      /FIXED  = WPnm PMnm0
      /RANDOM = INTERCEPT WPnm | SUBJECT(ID) COVTYPE(UN)
      /REPEATED = day | SUBJECT(ID) COVTYPE(ID)
      /TEST = "Within-Person Mood Effect"   WPnm  1
      /TEST = "Between-Person Mood Effect"  PMnm0 1
      /TEST = "Contextual Mood Effect"      PMnm0 1 WPnm -1.

* STATA Model 2b: Random Effect of WP Negative Mood using PMC
mixed lglucAM c.WPnm c.PMnm0, || id: WPnm,      ///
        variance ml covariance(un)  residuals(independent,t(day)),
      estat ic, n(207),
      estimates store RandWP,
      lrtest RandWP FixWP,
      lincom 1*c.WPnm                // within-person mood effect
      lincom 1*c.PMnm0               // between-person mood effect
      lincom 1*c.PMnm0 - 1*c.WPnm    // contextual mood effect
```

## SAS output:

Covariance Parameter Estimates

| Cov Parm | Subject | Estimate | Standard Error | Z Value | Pr Z |
|---|---|---|---|---|---|
| UN(1,1) | ID | 0.06440 | 0.006479 | 9.94 | <.0001 |
| UN(2,1) | ID | -0.00020 | 0.001067 | -0.19 | 0.8478 |
| UN(2,2) | ID | 0.000505 | 0.000335 | 1.51 | 0.0656 |
| Day | ID | 0.02995 | 0.000692 | 43.28 | <.0001 |

Information Criteria

| Neg2LogLike | Parms | AIC | AICC | HQIC | BIC | CAIC |
|---|---|---|---|---|---|---|
| -1959.4 | 7 | -1945.4 | -1945.4 | -1936.0 | -1922.1 | -1915.1 |

Solution for Fixed Effects

| Effect | Estimate | Standard Error | DF | t Value | Pr > \|t\| |
|---|---|---|---|---|---|
| Intercept | 4.9302 | 0.01846 | 207 | 267.10 | <.0001 |
| WPnm | 0.01104 | 0.004137 | 202 | 2.67 | 0.0083 |
| PMnm0 | 0.08022 | 0.03047 | 207 | 2.63 | 0.0091 |

Note the change in DF and SE for the now-random WPnm effect.

Estimates

| Label | Estimate | Standard Error | DF | t Value | Pr > \|t\| |
|---|---|---|---|---|---|
| Within-Person Effect | 0.01104 | 0.004137 | 202 | 2.67 | 0.0083 |
| Between-Person Effect | 0.08022 | 0.03047 | 207 | 2.63 | 0.0091 |
| Contextual Effect | 0.06918 | 0.03075 | 215 | 2.25 | 0.0255 |

```
* Calculate difference in model fit relative to fixed WPnm model;
%FitTest(FitFewer=FitMood, FitMore=FitRandMood);
```

Likelihood Ratio Test for FitMood vs. FitRandMood

| Name | Neg2Log Like | Parms | AIC | BIC | DevDiff | DFdiff | Pvalue |
|---|---|---|---|---|---|---|---|
| FitMood | -1956.5 | 5 | -1946.5 | -1929.9 | . | . | . |
| FitRandMood | -1959.4 | 7 | -1945.4 | -1922.1 | 2.90730 | 2 | 0.23372 |

Is this a better model than the fixed effects person-MC model (2a)? What does this result mean?
*It means that so far, each person does not need his or her own effect of worse negative mood than usual.*

## Model 2c. Adding Moderation Effects by Sex (0=M, 1=W) for Each Mood Effect under PMC

Level 1: $\text{Glucose}_{ti} = \beta_{0i} + \beta_{1i}\left(\text{Mood}_{ti} - \overline{\text{Mood}}_i\right) + e_{ti}$

Level 2: Intercept: $\beta_{0i} = \gamma_{00} + \gamma_{01}\left(\overline{\text{Mood}}_i - 0\right) + \gamma_{02}\left(\text{Woman}_i\right) + \gamma_{03}\left(\overline{\text{Mood}}_i - 0\right)\left(\text{Woman}_i\right) + U_{0i}$

Within-Person Mood: $\beta_{1i} = \gamma_{10} + \gamma_{12}\left(\text{Woman}_i\right)$

```
TITLE1 "SAS Model 2c: Fixed Effects of Sex (0=M, 1=W) by PMC Negative Mood";
PROC MIXED DATA=work.Example2 COVTEST NOCLPRINT NOITPRINT NAMELEN=100 IC METHOD=ML;
     CLASS ID day;
     MODEL lGlucAM = WPnm PMnm0 sexMW WPnm*sexMW PMnm0*sexMW
                     / SOLUTION DDFM=Satterthwaite OUTPM=PredSex;
     RANDOM INTERCEPT / SUBJECT=ID TYPE=UN;
     REPEATED day / SUBJECT=ID TYPE=VC;
     ODS OUTPUT CovParms=CovSex InfoCrit=FitSex; * Save covparms, fit;
     ESTIMATE "Intercept: Men (Mood=0)"          intercept 1 sexMW 0;
     ESTIMATE "Intercept: Women (Mood=0)"        intercept 1 sexMW 1;
     ESTIMATE "Intercept: Women Diff (Mood=0)"   sexMW 1;
```

```
     ESTIMATE "Within-Person Effect: Men"           WPnm 1 WPnm*sexMW 0;
     ESTIMATE "Within-Person Effect: Women"         WPnm 1 WPnm*sexMW 1;
     ESTIMATE "Within-Person Effect: Women Diff"    WPnm*sexMW 1;
     ESTIMATE "Between-Person Effect: Men"          PMnm0 1 PMnm0*sexMW 0;
     ESTIMATE "Between-Person Effect: Women"        PMnm0 1 PMnm0*sexMW 1;
     ESTIMATE "Between-Person Effect: Women Diff"   PMnm0*sexMW 1;
     ESTIMATE "Contextual Effect: Men"              WPnm -1 WPnm*sexMW  0 PMnm0 1 PMnm0*sexMW 0;
     ESTIMATE "Contextual Effect: Women"            WPnm -1 WPnm*sexMW -1 PMnm0 1 PMnm0*sexMW 1;
     ESTIMATE "Contextual Effect: Women Diff"       WPnm*sexMW -1 PMnm0*sexMW 1;
RUN; TITLE1;

ECHO "SPSS Model 2c: Fixed Effects of Sex (0=M, 1=W) by PMC Negative Mood".
MIXED lglucAM BY ID day WITH WPnm PMnm0 sexMW
 /METHOD = ML
 /PRINT  = SOLUTION TESTCOV
 /FIXED  = WPnm PMnm0 sexMW WPnm*sexMW PMnm0*sexMW
 /RANDOM = INTERCEPT | SUBJECT(ID) COVTYPE(UN)
 /REPEATED = day | SUBJECT(ID) COVTYPE(ID)
 /SAVE = FIXPRED (predsex)
 /TEST = "Intercept: Men (Mood=0)"                intercept 1 sexMW 0
 /TEST = "Intercept: Women (Mood=0)"              intercept 1 sexMW 1
 /TEST = "Intercept: Women Diff (Mood=0)"         sexMW 1
 /TEST = "Within-Person Mood Effect: Men"         WPnm 1 WPnm*sexMW 0
 /TEST = "Within-Person Mood Effect: Women"       WPnm 1 WPnm*sexMW 1
 /TEST = "Within-Person Mood Effect: Women Diff"  WPnm*sexMW 1
 /TEST = "Between-Person Mood Effect: Men"        PMnm0 1 PMnm0*sexMW 0
 /TEST = "Between-Person Mood Effect: Women"      PMnm0 1 PMnm0*sexMW 1
 /TEST = "Between-Person Mood Effect: Women Diff" PMnm0*sexMW 1
 /TEST = "Contextual Mood Effect: Men"            PMnm0 1 PMnm0*sexMW 0 WPnm -1 WPnm*sexMW  0
 /TEST = "Contextual Mood Effect: Women"          PMnm0 1 PMnm0*sexMW 1 WPnm -1 WPnm*sexMW -1
 /TEST = "Contextual Mood Effect: Women Diff"     PMnm0*sexMW 1 WPnm*sexMW -1.
CORRELATIONS lglucAM predsex.

 * STATA Model 2c: SPSS Model 2c: Fixed Effects of Sex (0=M, 1=W) by PMC Negative Mood
mixed lglucAM c.WPnm c.PMnm0 c.sexMW c.WPnm#c.sexMW c.PMnm0#c.sexMW, ///
        || id: ,  variance ml covariance(un) residuals(independent,t(day)),
      estat ic, n(207),
      estimates store Sexeffects,          // save LL for LRT
      lrtest Sexeffects FixWP,             // LRT against main effects model
      predict predsex,                     // save fixed-effect predicted outcomes
lincom 1*_cons + 0*c.sexMW                 // intercept: men (mood=0)
lincom 1*_cons + 1*c.sexMW                 // intercept: women (mood=0)
lincom 1*c.sexMW                           // intercept: women diff (mood=0)
lincom 1*c.WPnm + 0*c.WPnm#c.sexMW         // within-person mood effect: men
lincom 1*c.WPnm + 1*c.WPnm#c.sexMW         // within-person mood effect: women
lincom 1*c.WPnm#c.sexMW                    // within-person mood effect: women diff
lincom 1*c.PMnm0 + 0*c.PMnm0#c.sexMW       // between-person mood effect: men
lincom 1*c.PMnm0 + 1*c.PMnm0#c.sexMW       // between-person mood effect: women
lincom 1*c.PMnm0#c.sexMW                   // between-person mood effect: women diff
lincom 1*c.PMnm0 + 0*PMnm0#c.sexMW - 1*c.WPnm + 0*c.WPnm#c.sexMW     // contextual mood: men
lincom 1*c.PMnm0 + 1*pmnm0#c.sexMW - 1*c.WPnm - 1*c.WPnm#c.sexMW     // contextual mood: women
lincom 1*c.PMnm0#c.sexMW -1*WPnm#c.sexMW                             // contextual mood: women diff
margins, at(c.WPnm=(-1 0 1) c.PMnm0=(-1 1) c.sexMW=(0 1)) vsquish    // create predicted values
marginsplot, noci xdimension(WPnm)                                   // plot predicted, no CI
corr lglucAM predsex
```

## SAS output:

Covariance Parameter Estimates

| Cov Parm | Subject | Estimate | Standard Error | Z Value | Pr Z |
|---|---|---|---|---|---|
| UN(1,1) | ID | 0.06074 | 0.006118 | 9.93 | <.0001 |
| Day | ID | 0.03007 | 0.000678 | 44.35 | <.0001 |

Information Criteria

| Neg2LogLike | Parms | AIC | AICC | HQIC | BIC | CAIC |
|---|---|---|---|---|---|---|
| -1988.1 | 8 | -1972.1 | -1972.0 | -1961.3 | -1945.4 | -1937.4 |

Solution for Fixed Effects

| Effect | Estimate | Standard Error | DF | t Value | Pr > \|t\| |
|---|---|---|---|---|---|
| Intercept | 4.9539 | 0.02734 | 207 | 181.21 | <.0001 |
| WPnm | 0.03119 | 0.005937 | 3942 | 5.25 | <.0001 |
| PMnm0 | 0.1996 | 0.04849 | 207 | 4.12 | <.0001 |
| sexMW | -0.03619 | 0.03626 | 207 | -1.00 | 0.3194 |
| WPnm*sexMW | -0.03443 | 0.007743 | 3942 | -4.45 | <.0001 |
| PMnm0*sexMW | -0.1849 | 0.06135 | 207 | -3.01 | 0.0029 |

What does the intercept now represent in this model?
*The intercept of 4.9539 is the expected glucose level for a man with a mean negative mood score of 0, on an average day (WPnm = 0, too).*

What does the level-1 effect (WPnm) represent in this model?
*The level-1 effect is the simple within-person effect of negative mood specifically for a man. For every unit relative increase in your own negative mood that day, that day's glucose goes up by .03119 (significant).*

What does the level-2 effect (PMnm0) represent in this model?
*The level-2 effect is the simple between-person effect of negative mood specifically for a man. For every unit increase in your mean negative mood, mean glucose is higher by .1996 (significant).*

What does the main effect of sex represent in this model?
*The simple effect of sex is the difference between men and women for someone with a mean negative mood of 0 on day when they are at their mean. In those persons, women are -.03619 lower in mean glucose (n.s.).*

What does the WPnm*Sex interaction represent in this model?
*The WP*Sex interaction represents how the WP effect of negative mood varies by sex. For men, the WP effect is .03119 (WPnm effect), and the WP effect is .03443 smaller in women (significant interaction).*

What does the PMnm0*Sex interaction represent in this model?
*The BP*Sex interaction represents how the BP effect of negative mood varies by sex. For men, the BP effect is .1996 (PMnm0 effect), and the BP effect is .1849 smaller in women (significant interaction).*

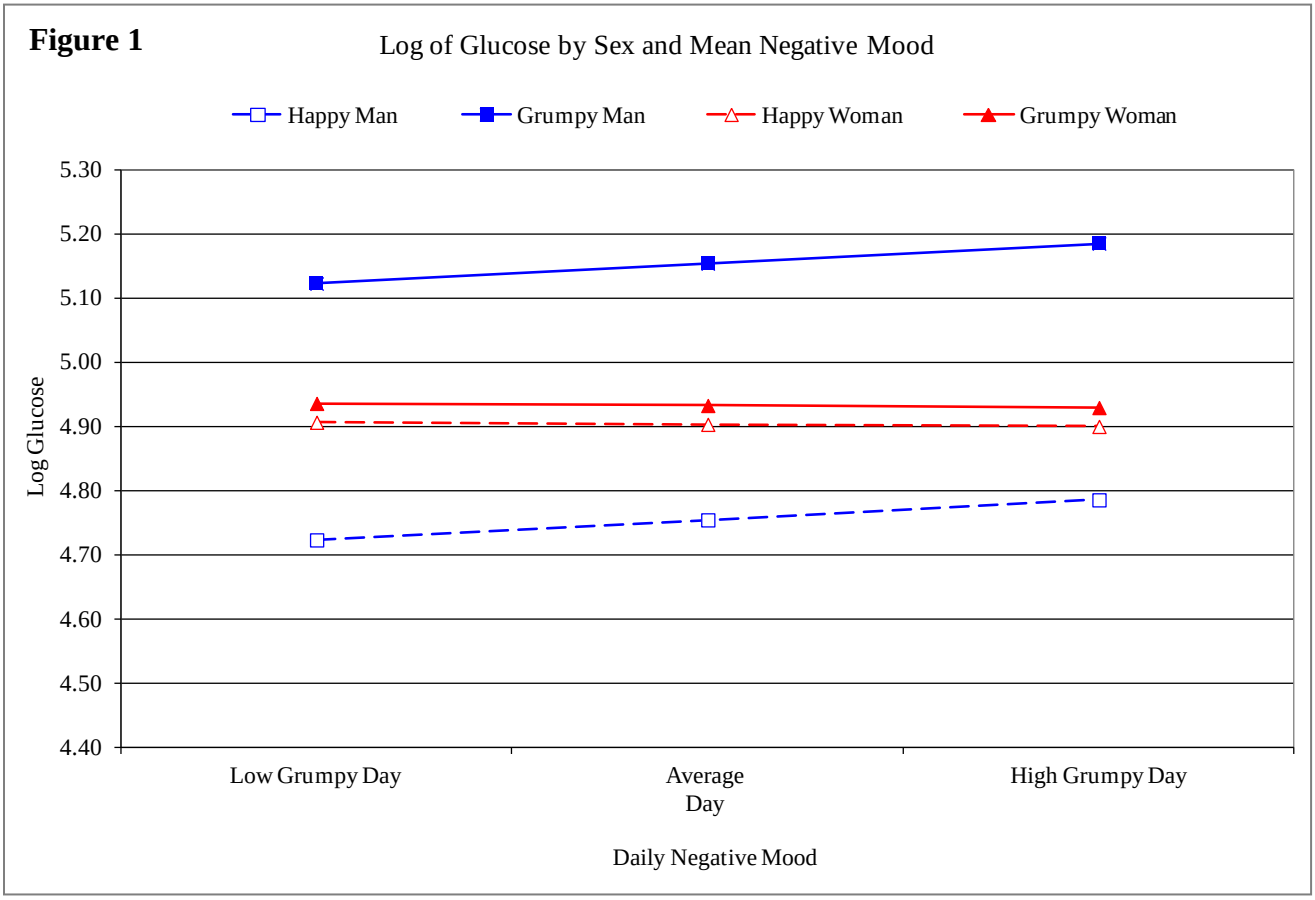
Estimates

| Label | Estimate | Standard Error | DF | t Value | Pr > \|t\| |
|---|---|---|---|---|---|
| Intercept: Men (Mood=0) | 4.9539 | 0.02734 | 207 | 181.21 | <.0001 |
| Intercept: Women (Mood=0) | 4.9177 | 0.02382 | 207 | 206.42 | <.0001 |
| Intercept: Women Diff (Mood=0) | -0.03619 | 0.03626 | 207 | -1.00 | 0.3194 |
| Within-Person Effect: Men | 0.03119 | 0.005937 | 3942 | 5.25 | <.0001 |
| Within-Person Effect: Women | -0.00325 | 0.004970 | 3942 | -0.65 | 0.5138 |
| Within-Person Effect: Women Diff | -0.03443 | 0.007743 | 3942 | -4.45 | <.0001 |
| Between-Person Effect: Men | 0.1996 | 0.04849 | 207 | 4.12 | <.0001 |
| Between-Person Effect: Women | 0.01469 | 0.03759 | 207 | 0.39 | 0.6962 |
| Between-Person Effect: Women Diff | -0.1849 | 0.06135 | 207 | -3.01 | 0.0029 |
| Contextual Effect: Men | 0.1684 | 0.04886 | 214 | 3.45 | 0.0007 |
| Contextual Effect: Women | 0.01794 | 0.03790 | 214 | 0.47 | 0.6364 |
| Contextual Effect: Women Diff | -0.1505 | 0.06184 | 214 | -2.43 | 0.0158 |

Which of these estimated effects were already given to us in the model?
*Effects for men as reference group: Intercept, WP mood, BP mood*
*Differences between men and women: Intercept difference (sex main effect), WP mood effect difference (sex*WP), BP mood effect difference (sex*BP)*

Which of these estimated effects were NOT already given to us in the model?
*Effects for women as alternative group: Intercept, WP mood effect, BP mood effect.*
*No contextual effects are given directly from the Person-MC, too.*

**Figure 1**




```
* Calculate PseudoR2 relative to fixed-mood-only model;
%PseudoR2(NCov=2, CovFewer=CovMood, CovMore=CovSex);
```

```
PsuedoR2 (% Reduction) for CovMood vs. CovSex

 Name      CovParm    Subject    Estimate      StdErr    ZValue     ProbZ    PseudoR2

CovMood    UN(1,1)      ID        0.06435    0.006474      9.94    <.0001      .
CovMood    day          ID        0.03022    0.000682     44.35    <.0001      .
CovSex     UN(1,1)      ID        0.06074    0.006118      9.93    <.0001    0.056080
CovSex     day          ID        0.03007    0.000678     44.35    <.0001    0.005027
```

Which new effects accounted for residual variance? *Sex*WPnm*

Which new effects accounted for random intercept variance? *Sex, Sex*PMnm0*

```
* Calculate Total R2 change relative to fixed-mood-only model;
%TotalR2(DV=lGlucAM, PredFewer=PredMood, PredMore=PredSex);
```

```
Total R2 (% Reduction) for PredMood vs. PredSex
             Pred                  Total
  Name       Corr      TotalR2     R2Diff
PredMood    0.15269    0.023315     .
PredSex     0.24931    0.062155    0.038840
```

What is the difference in the total reduction in glucose variance due to sex? *3.8% of the overall variance*

```
* Calculate difference in model fit relative to fixed-mood-only model;
%FitTest(FitFewer=FitMood, FitMore=FitSex);
```

```
Likelihood Ratio Test for FitMood vs. FitSex

           Neg2Log
 Name       Like      Parms       AIC        BIC     DevDiff    DFdiff       Pvalue
FitMood    -1956.5      5      -1946.5    -1929.9       .          .       .
FitSex     -1988.1      8      -1972.1    -1945.4    31.5122       3      .000000663
```

Is this total new reduction in variance significant? *Yes, according to the df=3 LRT against the mood-only model.*

## PART 3: GRAND-MEAN-CENTERING OF NEGATIVE MOOD TO PREDICT GLUCOSE

### Model 3. Predicting Glucose from Time-Varying Negative Mood only (GMC):

Level 1: $\text{Glucose}_{ti} = \beta_{0i} + \beta_{1i}(\text{Mood}_{ti} - 0) + e_{ti}$
Level 2: Intercept: $\beta_{0i} = \gamma_{00} + U_{0i}$
Time-Varying Mood: $\beta_{1i} = \gamma_{10}$

```
TITLE1 "SAS Model 3: Fixed Effect of TV Negative Mood only using GMC";
PROC MIXED DATA=work.Example2 COVTEST NOCLPRINT NOITPRINT NAMELEN=100 IC METHOD=ML;
     CLASS ID day;
     MODEL lglucAM = TVnm0 / SOLUTION DDFM=Satterthwaite;
     RANDOM INTERCEPT / SUBJECT=ID TYPE=UN;
     REPEATED day / SUBJECT=ID TYPE=VC;
     ODS OUTPUT CovParms=CovSmush; * Save covparms;
RUN; TITLE1;

ECHO "SPSS Model 3: Fixed Effect of TV Negative Mood only using GMC".
MIXED lglucAM BY ID day WITH TVnm0
      /METHOD = ML
      /PRINT  = SOLUTION TESTCOV
      /FIXED  = TVnm0
      /RANDOM = INTERCEPT | SUBJECT(ID) COVTYPE(UN)
      /REPEATED = day | SUBJECT(ID) COVTYPE(ID).

* STATA Model 3: Fixed Effect of TV Negative Mood only using GMC
mixed lglucAM c.TVnm0, || id: , variance ml covariance(un) residuals(independent,t(day)),
      estat ic, n(207)
```

### SAS output:

```
                Covariance Parameter Estimates
                                  Standard         Z
Cov Parm    Subject    Estimate       Error      Value      Pr > Z
UN(1,1)     ID         0.06595    0.006634       9.94      <.0001
Day         ID         0.03022    0.000682      44.34      <.0001
```

```
                          Information Criteria
Neg2LogLike     Parms         AIC        AICC         HQIC         BIC        CAIC
    -1951.5         4     -1943.5     -1943.5     -1938.1     -1930.2     -1926.2

                   Solution for Fixed Effects
                             Standard
Effect        Estimate         Error      DF    t Value    Pr > |t|
Intercept       4.9408       0.01806     207     273.52      <.0001
TVnm0          0.01202      0.003792    4041       3.17      0.0015
```

What does the level-1 effect of TVnm0 represent in this model?
*This is the combined ("smushed") BP and WP effect. For every 1-unit absolute increase in time-varying negative mood, there is a .01202 increase in glucose.*

```
* Calculate PseudoR2 relative to empty model;
%PseudoR2(NCov=2, CovFewer=CovEmpty, CovMore=CovSmush);
```

```
PsuedoR2 (% Reduction) for CovEmpty vs. CovSmush

  Name       CovParm     Subject     Estimate       StdErr     ZValue      ProbZ       PseudoR2
CovEmpty     UN(1,1)       ID         0.06654     0.006690       9.95     <.0001     .
CovEmpty     day           ID         0.03029     0.000683      44.35     <.0001     .
CovSmush     UN(1,1)       ID         0.06595     0.006634       9.94     <.0001     .008842272
CovSmush     day           ID         0.03022     0.000682      44.34     <.0001     .002088088
```

How much variance did the level-1 effect of TVnm0 account for? *.2% of residual and .9% of random intercept*

## Model 3a. Fixed Effects of Negative Mood using Grand-Mean-Centering (GMC)

Level 1: $Glucose_{ti} = \beta_{0i} + \beta_{1i}\left(Mood_{ti} - 0\right) + e_{ti}$

Level 2: Intercept: $\beta_{0i} = \gamma_{00} + \gamma_{01}\left(\overline{Mood}_{i} - 0\right) + U_{0i}$

Time-Varying Mood: $\beta_{1i} = \gamma_{10}$

```
TITLE1 "SAS Model 3a: Fixed Effects of Negative Mood using GMC";
PROC MIXED DATA=work.Example2 COVTEST NOCLPRINT NOITPRINT NAMELEN=100 IC METHOD=ML;
     CLASS ID day;
     MODEL lglucAM = TVnm0 PMnm0 / SOLUTION DDFM=Satterthwaite;
     RANDOM INTERCEPT / SUBJECT=ID TYPE=UN;
     REPEATED day / SUBJECT=ID TYPE=VC;
     ODS OUTPUT CovParms=CovMood InfoCrit=FitMood; * Save covparms, fit;
     ESTIMATE "Within-Person Mood Effect"    TVnm0 1;
     ESTIMATE "Between-Person Mood Effect"   TVnm0 1 PMnm0 1;
     ESTIMATE "Contextual Mood Effect"       PMnm0 1;
RUN; TITLE1;

ECHO "SPSS Model 3a: Fixed Effects of Negative Mood using GMC".
MIXED lglucAM BY ID day WITH TVnm0 PMnm0
      /METHOD = ML
      /PRINT  = SOLUTION TESTCOV
      /FIXED  = TVnm0 PMnm0
      /RANDOM = INTERCEPT | SUBJECT(ID) COVTYPE(UN)
      /REPEATED = day | SUBJECT(ID) COVTYPE(ID)
      /TEST = "Within-Person Mood Effect"   TVnm0 1
      /TEST = "Between-Person Mood Effect"  TVnm0 1 PMnm0 1
      /TEST = "Contextual Mood Effect"      PMnm0 1.

* STATA Model 3a: Fixed Effects of Negative Mood using GMC
mixed lglucAM c.TVnm0 c.PMnm0, || id: ,      ///
         variance ml covariance(un) residuals(independent,t(day)),
      estat ic, n(207),
```

```
estimates store FixTV,          // save LL for LRT
lincom 1*c.TVnm0                // within-person mood effect
lincom 1*c.TVnm0 + 1*c.PMnm0    // between-person mood effect
lincom 1*c.PMnm0                // contextual mood effect
```

**SAS output:**

Covariance Parameter Estimates

| Cov Parm | Subject | Estimate | Standard Error | Z Value | Pr > Z |
|---|---|---|---|---|---|
| UN(1,1) | ID | 0.06435 | 0.006474 | 9.94 | <.0001 |
| day | ID | 0.03022 | 0.000682 | 44.35 | <.0001 |

Information Criteria

| Neg2LogLike | Parms | AIC | AICC | HQIC | BIC | CAIC |
|---|---|---|---|---|---|---|
| -1956.5 | 5 | -1946.5 | -1946.5 | -1939.8 | -1929.9 | -1924.9 |

Solution for Fixed Effects

| Effect | Estimate | Standard Error | DF | t Value | Pr > \|t\| |
|---|---|---|---|---|---|
| Intercept | 4.9302 | 0.01845 | 207 | 267.20 | <.0001 |
| TVnm0 | 0.01097 | 0.003821 | 3941 | 2.87 | 0.0041 |
| PMnm0 | 0.06942 | 0.03070 | 213 | 2.26 | 0.0247 |

What does the level-1 effect (TVnm0) NOW represent in this model?
*The level-1 effect is now the within-person effect of negative mood. For every unit relative increase in your own negative mood that day, that day's glucose goes up by .01097 (WP relation among daily levels).*

What does the level-2 effect (PMnm0) represent in this model?
*The level-2 effect is now the person context effect of negative mood, or the test of the difference in the BP and WP effects. After controlling for absolute daily level of negative mood, for every unit increase in your own mean negative mood, overall glucose goes up by an additional .06942 ("extra" relation among average levels). Also, the BP effect is .06942 larger than the WP effect.*

```
* Calculate PseudoR2 relative to smushed model;
%PseudoR2(NCov=2, CovFewer=CovSmush, CovMore=CovMood);
```

PsuedoR2 (% Reduction) for CovSmush vs. CovMood

| Name | CovParm | Subject | Estimate | StdErr | ZValue | ProbZ | PseudoR2 |
|---|---|---|---|---|---|---|---|
| CovSmush | UN(1,1) | ID | 0.06595 | 0.006634 | 9.94 | <.0001 | . |
| CovSmush | day | ID | 0.03022 | 0.000682 | 44.34 | <.0001 | . |
| CovMood | UN(1,1) | ID | 0.06435 | 0.006474 | 9.94 | <.0001 | 0.024340 |
| CovMood | day | ID | 0.03022 | 0.000682 | 44.35 | <.0001 | 0.000017 |

How much variance did the level-2 effect of PMnm0 account for? *2.4% more than the smushed effect*

## Model 3b. Random Effect of TV Negative Mood under GMC

Level 1: $\text{Glucose}_{ti} = \beta_{0i} + \beta_{1i}\left(\text{Mood}_{ti} - 0\right) + e_{ti}$

Level 2: Intercept: $\beta_{0i} = \gamma_{00} + \gamma_{01}\left(\overline{\text{Mood}}_{i} - 0\right) + U_{0i}$

Time-Varying Mood: $\beta_{1i} = \gamma_{10} + U_{1i}$

```
TITLE1 "SAS Model 3b: Random Effect of TV Negative Mood using GMC";
PROC MIXED DATA=work.Example2 COVTEST NOCLPRINT NOITPRINT NAMELEN=100 IC METHOD=ML;
     CLASS ID day;
     MODEL lglucAM = TVnm0 PMnm0 / SOLUTION DDFM=Satterthwaite;
     RANDOM INTERCEPT TVnm0 / SUBJECT=ID TYPE=UN;
     REPEATED day / SUBJECT=ID TYPE=VC;
     ODS OUTPUT InfoCrit=FitTVRandMood; * Save fit;
     ESTIMATE "Within-Person Mood Effect"    TVnm0 1;
     ESTIMATE "Between-Person Mood Effect"   TVnm0 1 PMnm0 1;
     ESTIMATE "Contextual Mood Effect"       PMnm0 1;
RUN; TITLE1;

ECHO "SPSS Model 3b: Random Effect of TV Negative Mood using GMC".
MIXED lglucAM BY ID day WITH TVnm0 PMnm0
       METHOD = ML
      /PRINT  = SOLUTION TESTCOV
      /FIXED  = TVnm0 PMnm0
      /RANDOM = INTERCEPT TVnm0 | SUBJECT(ID) COVTYPE(UN)
      /REPEATED = day | SUBJECT(ID) COVTYPE(ID)
      /TEST = "Within-Person Mood Effect"    TVnm0 1
      /TEST = "Between-Person Mood Effect"   TVnm0 1 PMnm0 1
      /TEST = "Contextual Mood Effect"       PMnm0 1.

* STATA Model 3b: Random Effect of WP Negative Mood using GMC
mixed lglucAM c.TVnm0 c.PMnm0, || id: TVnm0,      ///
         variance ml covariance(un) residuals(independent,t(day)),
      estat ic, n(207),
      estimates store RandTV,          // save LL for LRT
      lrtest RandTV FixTV,             // LRT against fixed effect
      lincom 1*c.TVnm0                 // within-person mood effect
      lincom 1*c.TVnm0 + 1*c.PMnm0     // between-person mood effect
      lincom 1*c.PMnm0                 // contextual mood effect
```

## SAS output:

Covariance Parameter Estimates

| Cov Parm | Subject | Estimate | Standard Error | Z Value | Pr Z |
|---|---|---|---|---|---|
| UN(1,1) | ID | 0.06400 | 0.006464 | 9.90 | <.0001 |
| UN(2,1) | ID | -0.00033 | 0.001050 | -0.31 | 0.7549 |
| UN(2,2) | ID | 0.000579 | 0.000339 | 1.71 | 0.0441 |
| Day | ID | 0.02992 | 0.000690 | 43.34 | <.0001 |

Information Criteria

| Neg2LogLike | Parms | AIC | AICC | HQIC | BIC | CAIC |
|---|---|---|---|---|---|---|
| -1960.4 | 7 | -1946.4 | -1946.4 | -1937.0 | -1923.1 | -1916.1 |

Solution for Fixed Effects

| Effect | Estimate | Standard Error | DF | t Value | Pr > \|t\| |
|---|---|---|---|---|---|
| Intercept | 4.9302 | 0.01843 | 206 | 267.45 | <.0001 |
| TVnm0 | 0.01102 | 0.004181 | 205 | 2.64 | 0.0090 |
| PMnm0 | 0.07015 | 0.03066 | 214 | 2.29 | 0.0231 |

Estimates

| Label | Estimate | Standard Error | DF | t Value | Pr > \|t\| |
|---|---|---|---|---|---|
| Within-Person Effect | 0.01102 | 0.004181 | 205 | 2.64 | 0.0090 |
| Between-Person Effect | 0.08117 | 0.03047 | 209 | 2.66 | 0.0083 |
| Contextual Effect | 0.07015 | 0.03066 | 214 | 2.29 | 0.0231 |

Note that the PMC and GMC models no longer yield equivalent results if the level-1 effect is random.

```
* Calculate difference in model fit relative to fixed-mood-only model;
%FitTest(FitFewer=FitMood, FitMore=FitTVRandMood);
```

```
Likelihood Ratio Test for FitMood vs. FitTVRandMood

                Neg2Log
Name             Like      Parms       AIC        BIC     DevDiff    DFdiff     Pvalue
FitMood         -1956.5       5     -1946.5    -1929.9       .          .         .
FitTVRandMood   -1960.4       7     -1946.4    -1923.1     3.85979      2       0.14516
```

Is this a better model than the fixed effects grand-MC model (3b)? What does this result mean?
*It means that so far, each person does not need his or her own effect of worse negative mood (than usual).*

## Model 3c. Adding Moderation Effects by Sex (0=M, 1=W) for Each Mood Effect under GMC

Level 1: $\text{Glucose}_{ti} = \beta_{0i} + \beta_{1i}\left(\text{Mood}_{ti} - 0\right) + e_{ti}$

Level 2: Intercept: $\beta_{0i} = \gamma_{00} + \gamma_{01}\left(\overline{\text{Mood}}_i - 0\right) + \gamma_{02}\left(\text{Woman}_i\right) + \gamma_{03}\left(\overline{\text{Mood}}_i - 0\right)\left(\text{Woman}_i\right) + U_{0i}$

Time-Varying Mood: $\beta_{1i} = \gamma_{10} + \gamma_{12}\left(\text{Woman}_i\right)$

```
TITLE1 "SAS Model 3c: Fixed Effects of Sex (0=M, 1=W) by GMC Negative Mood";
PROC MIXED DATA=work.Example2 COVTEST NOCLPRINT NOITPRINT NAMELEN=100 IC METHOD=ML;
     CLASS ID day;
     MODEL lGlucAM = TVnm0 PMnm0 sexMW TVnm0*sexMW PMnm0*sexMW
                     / SOLUTION DDFM=Satterthwaite OUTPM=PredSex;
     RANDOM INTERCEPT / SUBJECT=ID TYPE=UN;
     REPEATED day / SUBJECT=ID TYPE=VC;
     ODS OUTPUT CovParms=CovSex InfoCrit=FitSex; * Save covparms, fit;
     ESTIMATE "Intercept: Men"                    intercept 1 sexMW 0;
     ESTIMATE "Intercept: Women"                  intercept 1 sexMW 1;
     ESTIMATE "Intercept: Women Diff"             sexMW 1;
     ESTIMATE "Within-Person Effect: Men"         TVnm0 1 TVnm0*sexMW 0;
     ESTIMATE "Within-Person Effect: Women"       TVnm0 1 TVnm0*sexMW 1;
     ESTIMATE "Within-Person Effect: Women Diff"  TVnm0*sexMW 1;
     ESTIMATE "Between-Person Effect: Men"        TVnm0 1 TVnm0*sexMW 0 PMnm0 1 PMnm0*sexMW 0;
     ESTIMATE "Between-Person Effect: Women"      TVnm0 1 TVnm0*sexMW 1 PMnm0 1 PMnm0*sexMW 1;
     ESTIMATE "Between-Person Effect: Women Diff" TVnm0*sexMW 1 PMnm0*sexMW 1;
     ESTIMATE "Contextual Effect: Men"            PMnm0 1 PMnm0*sexMW 0;
     ESTIMATE "Contextual Effect: Women"          PMnm0 1 PMnm0*sexMW 1;
     ESTIMATE "Contextual Effect: Women Diff"     PMnm0*sexMW 1;
RUN; TITLE1;

ECHO "SPSS Model 3c: Fixed Effects of Sex (0=M, 1=W) by GMC Negative Mood".
MIXED lglucAM BY ID day WITH TVnm0 PMnm0 sexMW
 /METHOD = ML
 /PRINT  = SOLUTION TESTCOV
 /FIXED  = TVnm0 PMnm0 sexMW TVnm0*sexMW PMnm0*sexMW
 /RANDOM = INTERCEPT | SUBJECT(ID) COVTYPE(UN)
 /REPEATED = day | SUBJECT(ID) COVTYPE(ID)
 /TEST = "Intercept: Men (Mood=0)"                intercept 1 sexMW 0
 /TEST = "Intercept: Women (Mood=0)"              intercept 1 sexMW 1
 /TEST = "Intercept: Women Diff (Mood=0)"         sexMW 1
 /TEST = "Within-Person Mood Effect: Men"         TVnm0 1 TVnm0*sexMW 0
 /TEST = "Within-Person Mood Effect: Women"       TVnm0 1 TVnm0*sexMW 1
 /TEST = "Within-Person Mood Effect: Women Diff"  TVnm0*sexMW 1
 /TEST = "Between-Person Mood Effect: Men"        TVnm0 1 TVnm0*sexMW 0 PMnm0 1 PMnm0*sexMW 0
 /TEST = "Between-Person Mood Effect: Women"      TVnm0 1 TVnm0*sexMW 1 PMnm0 1 PMnm0*sexMW 1
 /TEST = "Between-Person Mood Effect: Women Diff" TVnm0*sexMW 1 PMnm0*sexMW 1
 /TEST = "Contextual Mood Effect: Men"            PMnm0 1 PMnm0*sexMW 0
 /TEST = "Contextual Mood Effect: Women"          PMnm0 1 PMnm0*sexMW 1
 /TEST = "Contextual Mood Effect: Women Diff"     PMnm0*sexMW 1.
```

```
* STATA Model 3c: Fixed Effects of Sex (0=M, 1=W) by GMC Negative Mood
mixed lglucAM c.TVnm0 c.PMnm0 c.sexMW c.TVnm0#c.sexMW c.PMnm0#c.sexMW, ///
         || id: ,  variance ml covariance(un) residuals(independent,t(day)),
      estat ic, n(207),
lincom 1*_cons + 0*c.sexMW                          // intercept: men (mood=0)
lincom 1*_cons + 1*c.sexMW                          // intercept: women (mood=0)
lincom 1*c.sexMW                                    // intercept: women diff (mood=0)
lincom 1*c.TVnm0 + 0*c.TVnm0#c.sexMW                // within-person mood effect: men
lincom 1*c.TVnm0 + 1*c.TVnm0#c.sexMW                // within-person mood effect: women
lincom 1*c.TVnm0#c.sexMW                            // within-person mood effect: women diff
lincom 1*c.TVnm0 + 0*c.TVnm0#c.sexMW + 1*c.PMnm0 + 0*c.PMnm0#c.sexMW // between-person: men
lincom 1*c.TVnm0 + 1*c.TVnm0#c.sexMW + 1*c.PMnm0 + 1*c.PMnm0#c.sexMW // between-person: women
lincom 1*c.TVnm0#c.sexMW + 1*c.PMnm0#c.sexMW                        // between-person: women diff
lincom 1*c.PMnm0 + 0*c.PMnm0#c.sexMW                // contextual mood effect: men
lincom 1*c.PMnm0 + 1*c.PMnm0#c.sexMW                // contextual mood effect: women
lincom 1*c.PMnm0#c.sexMW                            // contextual mood effect: women diff
```

## SAS output:

Covariance Parameter Estimates

| Cov Parm | Subject | Estimate | Standard Error | Z Value | Pr > Z |
|---|---|---|---|---|---|
| UN(1,1) | ID | 0.06074 | 0.006118 | 9.93 | <.0001 |
| Day | ID | 0.03007 | 0.000678 | 44.35 | <.0001 |

Information Criteria

| Neg2LogLike | Parms | AIC | AICC | HQIC | BIC | CAIC |
|---|---|---|---|---|---|---|
| -1988.1 | 8 | -1972.1 | -1972.0 | -1961.3 | -1945.4 | -1937.4 |

Solution for Fixed Effects

| Effect | Estimate | Standard Error | DF | t Value | Pr > \|t\| |
|---|---|---|---|---|---|
| Intercept | 4.9539 | 0.02734 | 207 | 181.21 | <.0001 |
| TVnm0 | 0.03119 | 0.005937 | 3942 | 5.25 | <.0001 |
| PMnm0 | 0.1684 | 0.04886 | 214 | 3.45 | 0.0007 |
| sexMW | -0.03619 | 0.03626 | 207 | -1.00 | 0.3194 |
| TVnm0*sexMW | -0.03443 | 0.007743 | 3942 | -4.45 | <.0001 |
| PMnm0*sexMW | -0.1505 | 0.06184 | 214 | -2.43 | 0.0158 |

Estimates

| Label | Estimate | Standard Error | DF | t Value | Pr > \|t\| |
|---|---|---|---|---|---|
| Intercept: Men | 4.9539 | 0.02734 | 207 | 181.21 | <.0001 |
| Intercept: Women | 4.9177 | 0.02382 | 207 | 206.42 | <.0001 |
| Intercept: Women Diff | -0.03619 | 0.03626 | 207 | -1.00 | 0.3194 |
| | | | | | |
| Within-Person Effect: Men | 0.03119 | 0.005937 | 3942 | 5.25 | <.0001 |
| Within-Person Effect: Women | -0.00325 | 0.004970 | 3942 | -0.65 | 0.5138 |
| Within-Person Effect: Women Diff | -0.03443 | 0.007743 | 3942 | -4.45 | <.0001 |
| | | | | | |
| Between-Person Effect: Men | 0.1996 | 0.04849 | 207 | 4.12 | <.0001 |
| Between-Person Effect: Women | 0.01469 | 0.03759 | 207 | 0.39 | 0.6962 |
| Between-Person Effect: Women Diff | -0.1849 | 0.06135 | 207 | -3.01 | 0.0029 |
| | | | | | |
| Contextual Effect: Men | 0.1684 | 0.04886 | 214 | 3.45 | 0.0007 |
| Contextual Effect: Women | 0.01794 | 0.03790 | 214 | 0.47 | 0.6364 |
| Contextual Effect: Women Diff | -0.1505 | 0.06184 | 214 | -2.43 | 0.0158 |

```
* Calculate PseudoR2 relative to fixed-mood-only model;
%PseudoR2(NCov=2, CovFewer=CovMood, CovMore=CovSex);
```

```
PsuedoR2 (% Reduction) for CovMood vs. CovSex

 Name      CovParm    Subject    Estimate      StdErr    ZValue     ProbZ    PseudoR2
CovMood    UN(1,1)      ID        0.06435    0.006474      9.94    <.0001      .
CovMood    day          ID        0.03022    0.000682     44.35    <.0001      .
CovSex     UN(1,1)      ID        0.06074    0.006118      9.93    <.0001    0.056080
CovSex     day          ID        0.03007    0.000678     44.35    <.0001    0.005027
```

Which new effects accounted for residual variance? *Sex*TVnm0*

Which new effects accounted for random intercept variance? *Sex, Sex*PMnm0, Sex*TVnm0*

```
* Calculate Total R2 change relative to fixed-mood-only model;
%TotalR2(DV=lGlucAM, PredFewer=PredMood, PredMore=PredSex);
```

```
Total R2 (% Reduction) for PredMood vs. PredSex

             Pred                  Total
  Name       Corr      TotalR2     R2Diff
PredMood    0.15269    0.023315     .
PredSex     0.24931    0.062155    0.038840
```

What is the difference in the total reduction in glucose variance due to sex? *3.8% of the overall variance*

```
* Calculate difference in model fit relative to fixed-mood-only model;
%FitTest(FitFewer=FitMood, FitMore=FitSex);
```

```
Likelihood Ratio Test for FitMood vs. FitSex

           Neg2Log
 Name       Like      Parms        AIC        BIC     DevDiff    DFdiff        Pvalue
FitMood    -1956.5       5     -1946.5    -1929.9       .           .       .
FitSex     -1988.1       8     -1972.1    -1945.4    31.5122        3      .000000663
```

Is this total new reduction in variance significant? *Yes, according to the df=3 LRT against the mood-only model.*

Sample Results Section for Example 2a (note that the order of the models is different than what is in this handout):

The effects of negative mood and sex on next day's morning glucose level were examined in 207 persons with type-2 diabetes over a 20-day period. Glucose was natural log transformed (after adding 1 to each score) to improve normality. Intraclass correlations as calculated from an empty means,, random intercept only model were .69 for glucose and .39 for negative mood, such that 69% and 39% of the variance in each variable was between persons, respectively. Preliminary analyses suggested that a random intercept only model for the variances of glucose over time had acceptable fit, and thus all conditional (predictor) models were examined using that structure as a baseline.

The time-varying (level-1) predictor for negative mood (left uncentered, given that 0 represented average level of the measure) was first entered into the model. A significant positive effect was obtained, such that higher daily levels of negative mood were related to higher daily levels of glucose. However, the inclusion of a single parameter for the effect of negative mood presumes that its between-person and within-person effects would be equivalent. This convergence hypothesis was tested explicitly by including person mean negative mood (also left uncentered, given that 0 represented average level of the original measure) as a level-2 predictor. The effect of person mean negative mood was significant, indicating that after controlling for absolute level of daily negative mood, persons with higher mean negative mood had higher mean glucose. Given that the significance of the level-2 effect also indicates that the between-person and within-person effects of negative mood were not equivalent, the model was re-specified to facilitate interpretation of these separate effects using group-mean-centering (i.e., person-mean-centering in longitudinal data). Specifically, a new level-1 predictor variable was created by subtracting each person's mean from daily negative mood, while the level-2 effect continued to be represented by the person mean. In this specification using person-mean-centering, the level-2 mean of negative mood represents the between-person effect directly and the level-1 within-person deviation of negative mood represents the within-person effect directly. Both the between- and within-person effects of negative mood were significantly positive. A random level-1 effect of negative mood was tested within both models, and was not found to be significant in either, $-2\Delta LL$ (~2) < 5.14, $p > .05$, indicating no significant individual differences in the within-person effect of negative mood.

Three effects of sex were then entered into the person-mean-centered model, including a main effect of sex and interactions with the between- and within-person effects of negative mood. The main effect of sex was non-significant, indicating no sex differences in mean glucose among persons with average levels of mean negative mood on average days (i.e., when average persons were at their mean). Given that both interactions were significant, however, results for both men and women will be presented as derived from ESTIMATE statements for the effects estimated specifically for each group within the overall model. Parameters for this final model are given in Table 1.

As shown, the intercept of 4.95 represents the expected morning LN glucose for a man with an average level of mean negative mood on an average day (i.e., both mean and person-mean-centered negative mood at 0). Men showed significant between- and within-person effects of negative mood, such that for every unit higher in mean negative mood, mean glucose was expected to be 0.20 higher (i.e., the between-person effect), and for every unit higher in negative mood on a given day relative to his own mean, glucose that next morning was expected to be 0.03 higher as well (i.e., the within-person effect). Thus, in men, being higher overall in negative mood and higher than usual in negative mood were each related to higher levels of glucose, and these effects were significantly different in magnitude (contextual effect = 0.17, SE =0 .05, $p < .001$). Said differently the contextual effect also indicates a significant contribution of person mean negative mood after controlling for daily negative mood.

As shown in Figure 1, however, these patterns were not found in women, as indicated by the significant interactions with sex. Specifically, the between-person and within-person effects of negative mood in women were 0.015 (SE = 0.038) and −0.003 (SE = 0.005), respectively. Neither effect was significant nor did they differ significantly in magnitude (contextual effect = 0.018, SE = .038). Both effects of negative mood were significantly smaller than in men (interaction terms of sex with between-person and within-person negative mood of −0.185 and −0.034, respectively). Finally, the contextual effect of negative mood, or the difference between the between-person and within-person effects of negative mood, was significantly larger for men (0.151, SE = 0.062, $p = .016$).

(Table 1 would have all parameter estimates from final model, see my chapter 8 for examples)