# Testing Indirect Effects for Lower level Mediation Models in SPSS

Here we provide syntax for fitting the lower-level mediation model using the MIXED procedure in SPSS as well as an excel calculator, **SPSSEffectsCalc.xls,** that performs the computations necessary for evaluating the average indirect and total effects. In addition, a simulated data file is provided, named **sim.sas7bdat**, to which the lower level mediation model can be fit. The population model from which the simulated data were generated has the following form:

$$M_{ij} = d_{Mj} + a_j X_{ij} + e_{Mij}$$
$$Y_{ij} = d_{Yj} + b_j M_{ij} + c'_j X_{ij} + e_{Yij}$$

In the population, the fixed-effects are $d_M = d_Y = 0$, $a = b = .6$ and $c' = .2$ and the variances of the random effects are $VAR(d_{Mj}) = .6$, $VAR(d_{Yj}) = .4$, $VAR(a_j) = VAR(b_j) = .16$ and $VAR(c'_j) = .04$. The covariance between $a_j$ and $b_j$ is $\sigma_{a_j,b_j} = .113$, and all other random effects are uncorrelated. These values imply that the average indirect and total effects in the population are .473 and .673, respectively. Last, the Level 1 residual variances are $VAR(e_{Mij}) = .65$ and $VAR(e_{Yij}) = .45$. In the simulated data, the number of Level 2 units (indicated by *j*) is $N = 100$, the number of observations within each Level 2 unit (indicated by *i*) is $n_j = 8$. We recommend saving the simulated data file to a directory on the users computer (e.g., c:\example\) to be analyzed using the provided syntax. We now show the SPSS syntax for fitting the model to the data using the procedures described in Bauer, Preacher, and Gil (2006).

## Restructuring Data in SPSS

The data must first be prepared for the analysis through the creation of a single dependent variable (Z) from the values of the mediator (M) and the distal outcome (Y). Two selection variables are also created, labeled Sy and Sm, to indicate when Z represents M versus Y. This rearrangement of the data is shown visually in Table 1 of Bauer, Preacher, and Gil (2006). Here we show how to accomplish this rearrangement using SPSS. SAS syntax is provided in other online

material showing how to structure the data and fit the model within SAS. The SPSS syntax for restructuring the data is as follows:

```
*Creating Md variable to use in data restructuring.
COMPUTE Md = m .
EXECUTE .

*Restructuring data for multilevel analysis.
VARSTOCASES /ID = obs
 /MAKE Z FROM Md y
 /INDEX = Index1(Z)
 /KEEP =  m x id.
```

The first part of the syntax generates Md as the dependent M variable to be used to construct the single dependent variable (Z). Although Md is redundant with M, this redundancy allows for the creation of Z from Y and M (now Md) and the retention of M as a predictor of Y within Z. The VARSTOCASES statement begins the data restructuring, with /ID = obs creating a variable (obs) to identify the row at which the observations were located in the original data file. The /MAKE Z FROM Md y statement creates the single dependent variable (Z) by stacking the values of the dependent mediator (Md) and the distal outcome (Y) so each measurement appears on a separate row. The statement /INDEX = Index1(Z) creates a variable (Index1) to distinguish Y from M values. The /KEEP = m x id statement indicates which variables should be kept as fixed variables, any variables that should appear in each row for a given observation. The following page includes visual representations of the data set with the Md variable and the restructured data set.

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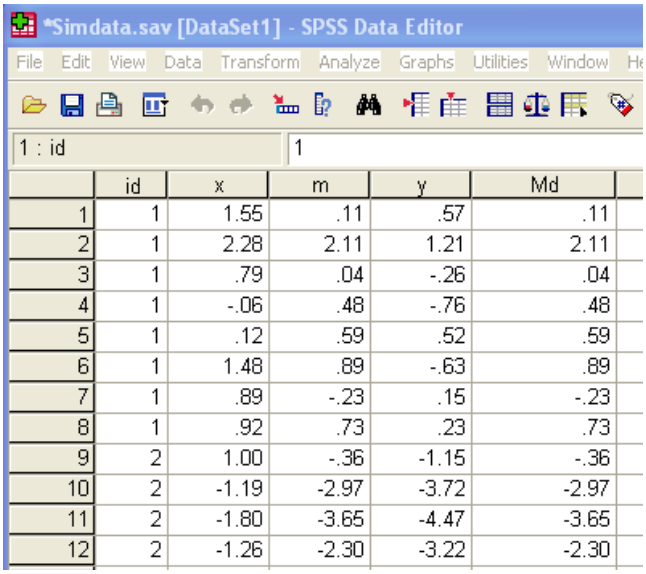
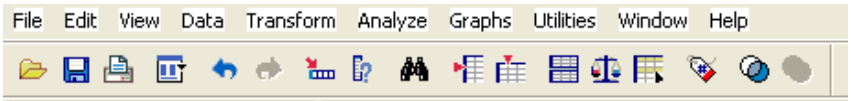
**First 12 observations of the data set with the Md variable:**




| | id | x | m | y | Md |
|---|---|---|---|---|---|
| 1 | 1 | 1.55 | .11 | .57 | .11 |
| 2 | 1 | 2.28 | 2.11 | 1.21 | 2.11 |
| 3 | 1 | .79 | .04 | -.26 | .04 |
| 4 | 1 | -.06 | .48 | -.76 | .48 |
| 5 | 1 | .12 | .59 | .52 | .59 |
| 6 | 1 | 1.48 | .89 | -.63 | .89 |
| 7 | 1 | .89 | -.23 | .15 | -.23 |
| 8 | 1 | .92 | .73 | .23 | .73 |
| 9 | 2 | 1.00 | -.36 | -1.15 | -.36 |
| 10 | 2 | -1.19 | -2.97 | -3.72 | -2.97 |
| 11 | 2 | -1.80 | -3.65 | -4.47 | -3.65 |
| 12 | 2 | -1.26 | -2.30 | -3.22 | -2.30 |

**Restructured data:**




| | obs | m | x | id | Index1 | Z |
|---|---|---|---|---|---|---|
| 1 | 1 | .11 | 1.55 | 1 | Md | .11 |
| 2 | 1 | .11 | 1.55 | 1 | y | .57 |
| 3 | 2 | 2.11 | 2.28 | 1 | Md | 2.11 |
| 4 | 2 | 2.11 | 2.28 | 1 | y | 1.21 |
| 5 | 3 | .04 | .79 | 1 | Md | .04 |
| 6 | 3 | .04 | .79 | 1 | y | -.26 |
| 7 | 4 | .48 | -.06 | 1 | Md | .48 |
| 8 | 4 | .48 | -.06 | 1 | y | -.76 |
| 9 | 5 | .59 | .12 | 1 | Md | .59 |
| 10 | 5 | .59 | .12 | 1 | y | .52 |
| 11 | 6 | .89 | 1.48 | 1 | Md | .89 |
| 12 | 6 | .89 | 1.48 | 1 | y | -.63 |
| 13 | 7 | -.23 | .89 | 1 | Md | -.23 |
| 14 | 7 | -.23 | .89 | 1 | y | .15 |
| 15 | 8 | .73 | .92 | 1 | Md | .73 |
| 16 | 8 | .73 | .92 | 1 | y | .23 |
| 17 | 9 | -.36 | 1.00 | 2 | Md | -.36 |
| 18 | 9 | -.36 | 1.00 | 2 | y | -1.15 |
| 19 | 10 | -2.97 | -1.19 | 2 | Md | -2.97 |
| 20 | 10 | -2.97 | -1.19 | 2 | y | -3.72 |
| 21 | 11 | -3.65 | -1.80 | 2 | Md | -3.65 |
| 22 | 11 | -3.65 | -1.80 | 2 | y | -4.47 |
| 23 | 12 | -2.30 | -1.26 | 2 | Md | -2.30 |
| 24 | 12 | -2.30 | -1.26 | 2 | y | -3.22 |

Prepared by Ruth Mathiowetz and Daniel Bauer, 4/21/2008

# Testing Indirect Effects for Lower level Mediation Models in SPSS

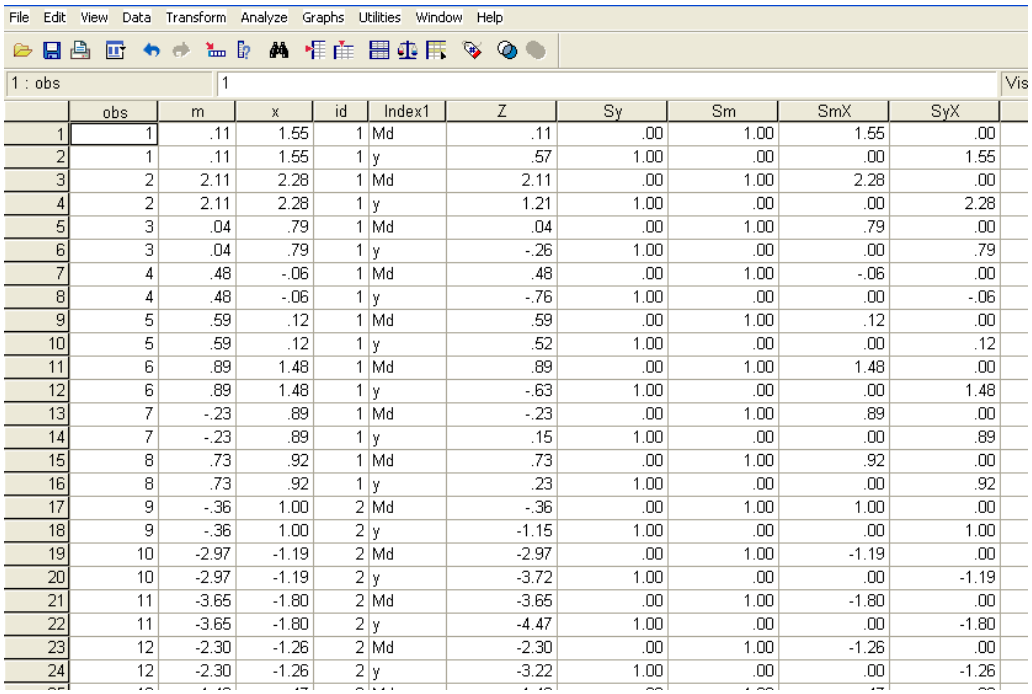
The following syntax creates the two selection variables labeled Sy and Sm, to indicate when Z represents M versus Y:

```
*Creating Sy indicator variable.
RECODE
  Index1
  ('Md'=0)  ('y'=1)  INTO  Sy .
VARIABLE LABELS Sy 'Sy'.
EXECUTE .
*Creating Sm indicator variable.
RECODE
  Index1
  ('Md'=1)  ('y'=0)  INTO  Sm .
VARIABLE LABELS Sm 'Sm'.
EXECUTE .
```

The following syntax creates the product variables SMX, SYX, and SYM for the analysis:

```
*Computing variables for analysis.
COMPUTE SmX = Sm * X .
EXECUTE .
COMPUTE SyX = Sy * X .
EXECUTE .
COMPUTE SyM = Sy * M .
EXECUTE .
```

The final data set should look like this:



File Edit View Data Transform Analyze Graphs Utilities Window Help

1 : obs | 1 | Vis

| | obs | m | x | id | Index1 | Z | Sy | Sm | SmX | SyX |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | .11 | 1.55 | 1 | Md | .11 | .00 | 1.00 | 1.55 | .00 |
| 2 | 1 | .11 | 1.55 | 1 | y | .57 | 1.00 | .00 | .00 | 1.55 |
| 3 | 2 | 2.11 | 2.28 | 1 | Md | 2.11 | .00 | 1.00 | 2.28 | .00 |
| 4 | 2 | 2.11 | 2.28 | 1 | y | 1.21 | 1.00 | .00 | .00 | 2.28 |
| 5 | 3 | .04 | .79 | 1 | Md | .04 | .00 | 1.00 | .79 | .00 |
| 6 | 3 | .04 | .79 | 1 | y | -.26 | 1.00 | .00 | .00 | .79 |
| 7 | 4 | .48 | -.06 | 1 | Md | .48 | .00 | 1.00 | -.06 | .00 |
| 8 | 4 | .48 | -.06 | 1 | y | -.76 | 1.00 | .00 | .00 | -.06 |
| 9 | 5 | .59 | .12 | 1 | Md | .59 | .00 | 1.00 | .12 | .00 |
| 10 | 5 | .59 | .12 | 1 | y | .52 | 1.00 | .00 | .00 | .12 |
| 11 | 6 | .89 | 1.48 | 1 | Md | .89 | .00 | 1.00 | 1.48 | .00 |
| 12 | 6 | .89 | 1.48 | 1 | y | -.63 | 1.00 | .00 | .00 | 1.48 |
| 13 | 7 | -.23 | .89 | 1 | Md | -.23 | .00 | 1.00 | .89 | .00 |
| 14 | 7 | -.23 | .89 | 1 | y | .15 | 1.00 | .00 | .00 | .89 |
| 15 | 8 | .73 | .92 | 1 | Md | .73 | .00 | 1.00 | .92 | .00 |
| 16 | 8 | .73 | .92 | 1 | y | .23 | 1.00 | .00 | .00 | .92 |
| 17 | 9 | -.36 | 1.00 | 2 | Md | -.36 | .00 | 1.00 | 1.00 | .00 |
| 18 | 9 | -.36 | 1.00 | 2 | y | -1.15 | 1.00 | .00 | .00 | 1.00 |
| 19 | 10 | -2.97 | -1.19 | 2 | Md | -2.97 | .00 | 1.00 | -1.19 | .00 |
| 20 | 10 | -2.97 | -1.19 | 2 | y | -3.72 | 1.00 | .00 | .00 | -1.19 |
| 21 | 11 | -3.65 | -1.80 | 2 | Md | -3.65 | .00 | 1.00 | -1.80 | .00 |
| 22 | 11 | -3.65 | -1.80 | 2 | y | -4.47 | 1.00 | .00 | .00 | -1.80 |
| 23 | 12 | -2.30 | -1.26 | 2 | Md | -2.30 | .00 | 1.00 | -1.26 | .00 |
| 24 | 12 | -2.30 | -1.26 | 2 | y | -3.22 | 1.00 | .00 | .00 | -1.26 |

Prepared by Ruth Mathiowetz and Daniel Bauer, 4/21/2008

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# Testing Indirect Effects for Lower level Mediation Models in SPSS

## Building the model

The model of interest is given by this equation:

$$Z_{ij} = d_{Mj}S_{Mij} + a_j(S_{Mij}X_{ij}) + d_{Yj}S_{Y_{ij}} + b_j(S_{Y_{ij}}M_{ij}) + c'_j(S_{Y_{ij}}X_{ij}) + e_{Zij}$$

The syntax for fitting this model in SPSS:

```
*Multilevel model.
MIXED
  Z  WITH Sy Sm SmX SyX SyM
  /FIXED = Sy Sm SmX SyX SyM  | NOINT SSTYPE(3)
  /METHOD = REML
  /PRINT = COVB G SOLUTION TESTCOV
  /RANDOM Sy Sm SmX SyX SyM  | SUBJECT(ID) COVTYPE(UN)
  /REPEATED Index1  | SUBJECT(obs*id) COVTYPE(DIAG) .
EXUCUTE .
```

The statement Z WITH Sy Sm SmX SyX SyM specifies the outcome variable (Z) and the covariates (Sy Sm SmX SyX SyM). The /FIXED statement identifies the fixed effects of the two selection variables (SY and SM), and the product variables (SMX, SYX and SYM). The NOINT option removes the intercept from the model and SSTYPE(3) is the default Sums of Squares test of significance. The /RANDOM statement identifies the coefficients that should have random effects and SUBJECT(ID) indicates the grouping variable. COVTYPE(UN) requests an unstructured covariance matrix. The /REPEATED statement is necessary to obtain a different Level 1 residual variances for Z when Z represents M versus Y (i.e., allowing for different residual variances for M and Y). The /PRINT statement requests estimates for the fixed effects (SOLUTION), the covariance matrix of the random effects (G), asymptotic covariance matrices for the fixed effects and covariance parameter estimates (COVB) (necessary for computing standard errors for the average indirect and total effects), and tests for the covariance estimates (TESTCOV).

# Testing Indirect Effects for Lower level Mediation Models in SPSS

## SPSS Output

Here we will describe the SPSS Output and which elements of the output are necessary to calculate the indirect and total effects. We will also identify where to put those values into the excel calculator, **SPSSEffectsCalc.xls,** to generate the estimated indirect and total effects, as well as their 95% confidence intervals. As stated previously the /REPEATED statement in our SPSS syntax allows for the estimation of heterogeneous $\sigma^2$ values for SY and SM. The estimates for the residual variance can be found in the Estimates of Covariance Parameters SPSS Output.

**Estimates of Covariance Parameters[a]**

| Parameter | | Estimate | Std. Error | Wald Z |
|---|---|---|---|---|
| Repeated Measures | Var: [Index1=Md] | .646731 | .036682 | 17.631 |
| | Var: [Index1=y ] | .508965 | .030674 | 16.593 |

The output indicates that the level 1 residual variance of SM is .647 and the residual variance of SY is .509, which are similar to the values used to generate the data ($VAR(e_{Mij}) = .65$, $VAR(e_{Yij}) = .45$).

# Testing Indirect Effects for Lower level Mediation Models in SPSS

To better indicate which values in the **Estimates of Fixed Effects** and **Covariance Matrix for Estimates of Fixed Effects** are used in the calculations as well as where the values should be entered into the calculator the values have been highlighted in both the SPSS output file and the excel calculator.

**Estimates of Fixed Effects[a]**

| Parameter | Estimate | Std. Error | df | t | Sig. | 95% Confidence Interval | |
|---|---|---|---|---|---|---|---|
| | | | | | | Lower Bound | Upper Bound |
| Sy | -.096852 | .061958 | 98.079 | -1.563 | .121 | -.219805 | .026101 |
| Sm | .093215 | .089432 | 99.016 | 1.042 | .300 | -.084236 | .270666 |
| SmX | .611857 | .046495 | 101.266 | 13.160 | .000 | .519625 | .704088 |
| SyX | .220812 | .037247 | 71.122 | 5.928 | .000 | .146545 | .295079 |
| SyM | .610563 | .045536 | 92.064 | 13.408 | .000 | .520125 | .701001 |

a. Dependent Variable: Z.

a
c'
b

**Covariance Matrix for Estimates of Fixed Effects[a]**

| Parameter | Sy | Sm | SmX | SyX | SyM |
|---|---|---|---|---|---|
| Sy | .003839 | .000576 | .000127 | -6E-005 | -.000114 |
| Sm | .000576 | .007998 | .000322 | -6E-005 | 9.3E-005 |
| SmX | .000127 | .000322 | .002162 | -.000197 | .000985 |
| SyX | -6E-005 | -6E-005 | -.000197 | .001387 | -.000484 |
| SyM | -.000114 | 9.3E-005 | .000985 | -.000484 | .002074 |

a. Dependent Variable: Z.

VAR(a)
VAR(c')
VAR(b)

| | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | |
| 2 | | Calculator for Random Indirect and Total Effects in Multilevel Models | | | | | | | |
| 3 | | Equations from Bauer, Preacher and Gil, 2006 | | | | | | | |
| 4 | | (Created by Ruth Mathiowetz, 4/21/2008) | | | | | | | |
| 5 | | | | | | | | | |
| 6 | **Fixed Effect and Variance-Covariance Parameter estimates** | | | | | | | | |
| 7 | | a | b | c' | | | | | |
| 8 | Gammas | 0.611857 | 0.610563 | 0.220812 | From **Estimates of Fixed Effects** | | | | |
| 9 | **Covariance Matrix of the Fixed effects** | | | | | | | | |
| 10 | | a | b | c' | | | | | |
| 11 | a | 0.002162 | X | X | From **Covariance Matrix for Estimates of Fixed Effects** | | | | |
| 12 | b | 0.000985 | 0.002074 | X | | | | | |
| 13 | c' | -0.000197 | -0.000484 | 0.001387 | | | | | |
| 14 | **Covariance Matrix of Random Slopes** | | | | | | | | |
| 15 | | a(j) | b(j) | c'(j) | | | | | |
| 16 | a(j) | 0.120483 | X | X | from **Random Effect Covariance Structure (G)** | | | | |
| 17 | b(j) | 0.098955 | 0.111872 | X | | | | | |
| 18 | c'(j) | -0.021496 | 0.005422 | 0.032437 | | | | | |
| 19 | | | | | | | | | |
| 20 | **Estimated Sampling Variance for Estimated Covariance Between a(j) and b(j) Random Effects** | | | | | | | | |
| 21 | var[cov(a(j),b(j))] | 0.000521 | From **Covariance Matrix for Estimates of Covariance Parameters** | | | | | | |

# Testing Indirect Effects for Lower level Mediation Models in SPSS

The other estimates needed for the calculations are located in the **Random Effect Covariance Structure (G)** and **Covariance Matrix for Estimates of Covariance Parameters** output from SPSS. As with the other SPSS output, the values used in the calculations and where those values should be entered into the calculator have been highlighted in both the **Random Effect Covariance Structure (G)** SPSS output and the excel calculator.

**Random Effect Covariance Structure (G)[a]**

| | Sy \| id | Sm \| id | SmX \| id | SyX \| id | SyM \| id |
|---|---|---|---|---|---|
| Sy \| id | .270284 | .056812 | .011881 | -.018276 | -.004284 |
| Sm \| id | .056812 | .679434 | .018161 | -.006674 | .009322 |
| SmX \| id | .011881 | .018161 | .120483 | -.021496 | .098955 |
| SyX \| id | -.018276 | -.006674 | -.021496 | .032437 | .005422 |
| SyM \| id | -.004284 | .009322 | .098955 | .005422 | .111872 |

VAR(a(j)) VAR(c'(j)) VAR(b(j))

Unstructured

a. Dependent Variable: Z.

| | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | |
| 2 | | Calculator for Random Indirect and Total Effects in Multilevel Models | | | | | | | |
| 3 | | Equations from Bauer, Preacher and Gil, 2006 | | | | | | | |
| 4 | | (Created by Ruth Mathiowetz, 4/21/2008) | | | | | | | |
| 5 | | | | | | | | | |
| 6 | **Fixed Effect and Variance-Covariance Parameter estimates** | | | | | | | | |
| 7 | | a | b | c' | | | | | |
| 8 | Gammas | 0.611857 | 0.610563 | 0.220812 | From **Estimates of Fixed Effects** | | | | |
| 9 | **Covariance Matrix of the Fixed effects** | | | | | | | | |
| 10 | | a | b | c' | | | | | |
| 11 | a | 0.002162 | X | X | From **Covariance Matrix for Estimates of Fixed Effects** | | | | |
| 12 | b | 0.000985 | 0.002074 | X | | | | | |
| 13 | c' | -0.000197 | -0.000484 | 0.001387 | | | | | |
| 14 | **Covariance Matrix of Random Slopes** | | | | | | | | |
| 15 | | a(j) | b(j) | c'(j) | | | | | |
| 16 | a(j) | 0.120483 | X | X | from **Random Effect Covariance Structure (G)** | | | | |
| 17 | b(j) | 0.098955 | 0.111872 | X | | | | | |
| 18 | c'(j) | -0.021496 | 0.005422 | 0.032437 | | | | | |
| 19 | | | | | | | | | |
| 20 | **Estimated Sampling Variance for Estimated Covariance Between a(j) and b(j) Random Effects** | | | | | | | | |
| 21 | | var[cov(a(j),b(j))] | 0.000521 | From **Covariance Matrix for Estimates of Covariance Parameters** | | | | | |

# Testing Indirect Effects for Lower level Mediation Models in SPSS

The estimated sampling covariance matrix for the covariance parameter estimates are found in the **Covariance Matrix for Estimates of Covariance Parameters** table of output. For our example, the column labeled UN(3,3) corresponds to the 3rd row and 3rd column of the **Random Effect Covariance Structure (G)** which is the variance of the random effect of SMX ($VAR(a_j)$). Thus the column labeled UN(3,3) contains the sampling variance of the estimate for $VAR(a_j)$ as well as the sampling covariances of this estimate with all other variance/covariance parameter estimates (indicated by the row index). Similarly the column labeled UN(4,4) contains the sampling (co)variances for estimates for the variance of the random effect of SYX ($VAR(c'_j)$) and the column labeled UN(5,5) refers to the estimated variance of the random effect of SYM ($VAR(b_j)$). What is needed for our calculations is the asymptotic variance of the covariance parameter $COV(a_j , b_j)$, which is labeled as UN(5,3). The sampling variance for this estimate will then be in the UN(5,3) row and column of the **Covariance Matrix for Estimates Covariance of Matrix Parameters** SPSS output. It has been highlighted in both the SPSS output and the excel calculator.

| | | | Sy + Sm + SmX + SyX + SyM [subject = id] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Parameter | | [I | N (3,2) | UN (3,3) | UN (4,1) | UN (4,2) | UN (4,3) | UN (4,4) | UN (5,1) | UN (5,2) | UN (5,3) |
| Repeated Measures | Var: [Index1=Md] | | E-005 | 1.0E-006 | 2.5E-005 | 3.5E-005 | -6E-006 | -.000155 | -2E-005 | -1E-005 | -5E-006 |
| | Var: [Index1=y] | 5.13 | 006 | -.000118 | 1.6E-005 | 7.8E-006 | -3E-005 | -8E-006 | -5E-006 | -9E-006 | 1.6E-005 |
| Sy + Sm + SmX + SyX + SyM [subject = id] | UN (1,1) | -3 | E-005 | -3E-007 | -7E-005 | -4E-005 | -2E-005 | -4E-005 | -3E-005 | 9.7E-005 | 1.4E-005 |
| | UN (2,1) | -1 | 00116 | -1E-007 | -9E-005 | -.000122 | .000220 | 6.1E-005 | 9.8E-005 | 7.5E-005 | -4E-005 |
| | UN (2,2) | - | 175 | -.000143 | -.000106 | -8E-005 | .000154 | 4.2E-005 | 4.1E-005 | .000118 | -.000108 |
| | UN (3,1) | -1 | 00133 | 9.8E-005 | -9E-005 | 1.4E-005 | -3E-005 | -2E-005 | .000393 | 6.5E-005 | 1.7E-005 |
| | UN (3,2) | 6. | 01688 | .000121 | 1.1E-005 | -8E-005 | -3E-005 | -2E-005 | 5.4E-005 | .000735 | 8.1E-005 |
| | UN (3,3) | - | 121 | .000859 | -7E-006 | -5E-006 | -9E-005 | 7.9E-006 | 3.1E-005 | 9.7E-005 | .000428 |
| | UN (4,1) | 1.5 | -005 | -7E-006 | .000544 | .000125 | -2E-005 | -9E-005 | -.000133 | 1.3E-005 | 6.3E-005 |
| | UN (4,2) | 7. | 9E-005 | -5E-006 | .000125 | .001191 | 3.2E-005 | -6E-005 | 1.1E-005 | -.000331 | 2.3E-005 |
| | UN (4,3) | -2.7 | 005 | -9E-005 | -2E-005 | 3.2E-005 | .000355 | -5E-005 | 6.1E-005 | -8E-006 | -.000107 |
| | UN (4,4) | -7 | -005 | 7.9E-006 | -9E-005 | -6E-005 | -5E-005 | .000402 | 1.3E-005 | 5.6E-006 | 1.2E-006 |
| | UN (5,1) | - | 4E-005 | 3.1E-005 | -.000133 | 1.1E-005 | 6.1E-005 | 1.3E-005 | .000774 | 6.5E-005 | 1.5E-005 |
| | UN (5,2) | -8.9 | 1735 | 9.7E-005 | 1.3E-005 | -.000331 | -8E-006 | 5.6E-006 | 6.5E-005 | .001521 | 7.3E-005 |
| | UN (5,3) | 1.5 | 005 | .000428 | 6.3E-005 | 2.3E-005 | -.000107 | 1.2E-006 | 1.5E-005 | 7.3E-005 | .000521 |
| | UN (5,4) | 4 | 9E-006 | -4E-005 | 2.0E-005 | 5.5E-005 | .000167 | -.000139 | 3.7E-005 | -1E-005 | -7E-005 |
| | UN (5,5) | -5.1 | -006 | .000196 | 4.1E-005 | -3E-005 | -6E-005 | 2.3E-005 | -4E-005 | 1.4E-005 | .000398 |

| | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | |
| 2 | | Calculator for Random Indirect and Total Effects in Multilevel Models | | | | | | | |
| 3 | | Equations from Bauer, Preacher and Gil, 2006 | | | | | | | |
| 4 | | (Created by Ruth Mathiowetz, 4/21/2008) | | | | | | | |
| 5 | | | | | | | | | |
| 6 | **Fixed Effect and Variance-Covariance Parameter estimates** | | | | | | | | |
| 7 | | a | b | c' | | | | | |
| 8 | Gammas | 0.611857 | 0.610563 | 0.220812 | From **Estimates of Fixed Effects** | | | | |
| 9 | **Covariance Matrix of the Fixed effects** | | | | | | | | |
| 10 | | a | b | c' | | | | | |
| 11 | a | 0.002162 | X | X | From **Covariance Matrix for Estimates of Fixed Effects** | | | | |
| 12 | b | 0.000985 | 0.002074 | X | | | | | |
| 13 | c' | -0.000197 | -0.000484 | 0.001387 | | | | | |
| 14 | **Covariance Matrix of Random Slopes** | | | | | | | | |
| 15 | | a(j) | b(j) | c'(j) | | | | | |
| 16 | a(j) | 0.120483 | X | X | from **Random Effect Covariance Structure (G)** | | | | |
| 17 | b(j) | 0.098955 | 0.111872 | X | | | | | |
| 18 | c'(j) | -0.021496 | 0.005422 | 0.032437 | | | | | |
| 19 | | | | | | | | | |
| 20 | **Estimated Sampling Variance for Estimated Covariance Between a(j) and b(j) Random Effects** | | | | | | | | |
| 21 | | var[cov(a(j),b(j))] | 0.000521 | From **Covariance Matrix for Estimates of Covariance Parameters** | | | | | |

# Testing Indirect Effects for Lower level Mediation Models in SPSS

Once all the estimates from all of the SPSS output are in the spreadsheet, it will calculate the formulas for the average (fixed) indirect and total effects (equations 5 and 7) and the standard errors (equation 9 and 10) and 95% confidence intervals (equations 11 and 12) of these average effect estimates. The variances of the random indirect and total effects are also computed (equations 6 and 8). The 95% CIs in this calculator are based on normal sampling distribution; the Monte Carlo (MC) method of constructing CI is not available with this calculator.

The final calculations:

Calculator for Random Indirect and Total Effects in Multilevel Models
Equations from Bauer, Preacher and Gil, 2006
(Created by Ruth Mathiowetz, 4/21/2008)

**Fixed Effect and Variance-Covariance Parameter estimates**

| | a | b | c' | |
|---|---|---|---|---|
| Gammas | 0.611857 | 0.610563 | 0.220812 | From **Estimates of Fixed Effects** |

**Covariance Matrix of the Fixed effects**

| | a | b | c' | |
|---|---|---|---|---|
| a | 0.002162 | X | X | From **Covariance Matrix for Estimates of Fixed Effects** |
| b | 0.000985 | 0.002074 | X | |
| c' | -0.000197 | -0.000484 | 0.001387 | |

**Covariance Matrix of Random Slopes**

| | a(j) | b(j) | c'(j) | |
|---|---|---|---|---|
| a(j) | 0.120483 | X | X | from **Random Effect Covariance Structure (G)** |
| b(j) | 0.098955 | 0.111872 | X | |
| c'(j) | -0.021496 | 0.005422 | 0.032437 | |

**Estimated Sampling Variance for Estimated Covariance Between a(j) and b(j) Random Effects**

| | | |
|---|---|---|
| var[cov(a(j),b(j))] | 0.000521 | From **Covariance Matrix for Estimates of Covariance Parameters** |

Random Indirect Effect

| eq. 5 | eq. 6 |
|---|---|
| Average | Variance |
| 0.472532245 | 0.184001364 |

Random Total Effect

| eq. 7 | eq. 8 |
|---|---|
| Average | Variance |
| 0.693344245 | 0.19682402 |

Random Indirect Effect

| eq. 5 | sqrt(eq. 9) | eq. 11 | | | |
|---|---|---|---|---|---|
| | Standard | 95 % Confidence Interval (alpha=0.05) | | | |
| Average | Error | Lower | Upper | Z-value | p-value |
| 0.472532245 | 0.053336747 | 0.36799222 | 0.57707227 | 8.8594126 | 0 |

Random Total Effect

| eq. 7 | sqrt(eq.10) | eq. 12 | | | |
|---|---|---|---|---|---|
| | Standard | 95 % Confidence Interval (alpha=0.05) | | | |
| Average | Error | Lower | Upper | Z-value | p-value |
| 0.693344245 | 0.058300679 | 0.57907492 | 0.80761358 | 11.89255871 | 0 |

# Testing Indirect Effects for Lower level Mediation Models in SPSS

## SPSS Syntax

```
*Creating Md variable to use in data restructuring.
COMPUTE Md = m .
EXECUTE .

*Restructuring data for multilevel analysis.
VARSTOCASES /ID = obs
 /MAKE Z FROM Md y
 /INDEX = Index1(Z)
 /KEEP =  m x id
 /NULL = KEEP.
EXECUTE .

*Creating Sy indicator variable.
RECODE
  Index1
  ('Md'=0)  ('y'=1)  INTO  Sy .
VARIABLE LABELS Sy 'Sy'.
EXECUTE .

*Creating Sm indicator variable.
RECODE
  Index1
  ('Md'=1)  ('y'=0)  INTO  Sm .
VARIABLE LABELS Sm 'Sm'.
EXECUTE .

*Computing variables for analysis.
COMPUTE SmX = Sm * X .
EXECUTE .
COMPUTE SyX = Sy * X .
EXECUTE .
COMPUTE SyM = Sy * M .
EXECUTE .

*Multilevel model.
MIXED
  Z  WITH Sy Sm SmX SyX SyM
  /FIXED = Sy Sm SmX SyX SyM  | NOINT SSTYPE(3)
  /METHOD = REML
  /PRINT = COVB G SOLUTION TESTCOV
  /RANDOM Sy Sm SmX SyX SyM  | SUBJECT(ID) COVTYPE(UN)
  /REPEATED Index1  | SUBJECT(obs*id) COVTYPE(DIAG) .
EXECUTE .
```