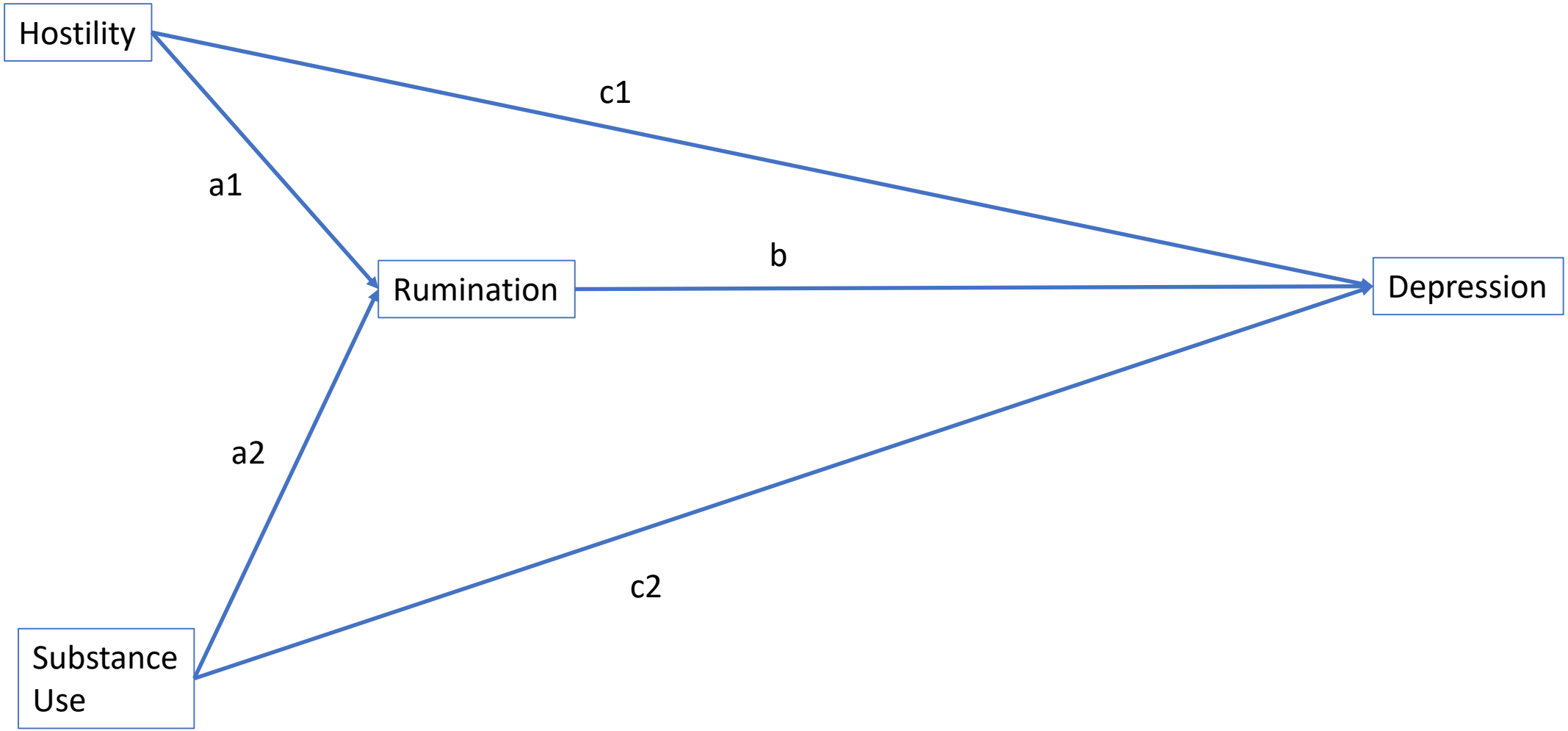
# Calculating Monte Carlo Confidence Intervals from Mplus Output

http://quantpsy.org/medmc/medmc.htm

# Here's a model



# Here's the code

```
TITLE:      Path Analysis All Continuous Variables
DATA:       FILE IS ex3.11.dat;

VARIABLE:
NAMES ARE depression HoB anxiety Host rumination Sub;

USEVARIABLES AREdepression  host rumination sub;

MODEL:
depression on host (c1);
depression on sub (c2);

rumination on host (a1);
rumination on sub (a2);

depression on rumination (b);

model constraint:
new (ind1 ind2);
ind1 = a1*b;
ind2 = a2*b;

Output:
tech1 tech3;
```

# Selected Results

MODEL RESULTS

| | Estimate | S.E. | Est./S.E. | Two-Tailed P-Value |
|---|---|---|---|---|
| DEPRESSI ON | | | | |
| HOST | 0.992 | 0.043 | 22.978 | 0.000 |
| SUB | 3.052 | 0.045 | 68.271 | 0.000 |
| RUMINATION | 2.001 | 0.045 | 44.616 | 0.000 |
| RUMINATI ON | | | | |
| HOST | 0.039 | 0.043 | 0.905 | 0.366 |
| SUB | 0.091 | 0.044 | 2.054 | 0.040 |
| Intercepts | | | | |
| DEPRESSION | -1.064 | 0.046 | -23.058 | 0.000 |
| RUMINATION | -0.028 | 0.046 | -0.600 | 0.549 |
| Residual Variances | | | | |
| DEPRESSION | 1.062 | 0.067 | 15.810 | 0.000 |
| RUMINATION | 1.055 | 0.067 | 15.811 | 0.000 |
| New/Additional Parameters | | | | |
| IND1 | 0.078 | 0.086 | 0.904 | 0.366 |
| IND2 | 0.182 | 0.089 | 2.051 | 0.040 |

# How many parameters did we estimate?

Right at the top of the output above the fit indices is the following statement:

```
MODEL FIT INFORMATION
Number of Free Parameters                       9
```

# Tech1 Matrices

**TAU**
The tau vector contains information regarding thresholds of categorical observed variables. The elements are in the order of thresholds within variables.

**NU**
The nu vector contains information regarding means or intercepts of continuous observed variables.

**LAMBDA**
The lambda matrix contains information regarding factor loadings. The rows of lambda represent the observed dependent variables in the model. The columns of lambda represent the continuous latent variables in the model.

**THETA**
The theta matrix contains the residual variances and covariances of the observed dependent variables or the latent response variables. The rows and columns both represent the observed dependent variables.

**ALPHA**
The alpha vector contains the means and/or intercepts of the continuous latent variables.

**BETA**
The beta matrix contains the regression coefficients for the regressions of continuous latent variables on continuous latent variables. Both the rows and columns represent continuous latent variables.

**GAMMA**
OUTPUT, SAVEDATA, And PLOT Commands
The gamma matrix contains the regression coefficients for the regressions of continuous latent variables on observed independent variables. The rows represent the continuous latent variables in the model. The columns represent the observed independent variables in the model.

**PSI**
The psi matrix contains the variances and covariances of the continuous latent variables. Both the rows and columns represent the continuous latent variables in the model.

**DELTA**
Delta is a vector that contains scaling information for the observed dependent variables.

# Tech1 Matrices – when all variables are observed

**TAU**
The tau vector contains information regarding thresholds of categorical observed variables. The elements are in the order of thresholds within variables.

**NU**
The nu vector contains information regarding means or intercepts of continuous observed variables.

**LAMBDA**
The lambda matrix contains information regarding factor loadings. The rows of lambda represent the observed dependent variables in the model. The columns of lambda represent the continuous latent variables in the model.

**THETA**
The theta matrix contains the residual variances and covariances of the observed dependent variables or the latent response variables. The rows and columns both represent the observed dependent variables.

**ALPHA**
The alpha vector contains the means and/or intercepts of the continuous latent variables.

**BETA**
The beta matrix contains the regression coefficients for the regressions of continuous latent variables on continuous latent variables. Both the rows and columns represent continuous latent variables.

**GAMMA**
OUTPUT, SAVEDATA, And PLOT Commands
The gamma matrix contains the regression coefficients for the regressions of continuous latent variables on observed independent variables. The rows represent the continuous latent variables in the model. The columns represent the observed independent variables in the model.

**PSI**
The psi matrix contains the variances and covariances of the continuous latent variables. Both the rows and columns represent the continuous latent variables in the model.

**DELTA**
Delta is a vector that contains scaling information for the observed dependent variables.

# Tech1

Tech1 provides the parameter numbers for each parameter in the model

TECHNICAL 1 OUTPUT

PARAMETER SPECIFICATION

NU

| | DEPRESSI | RUMINATI | HOST | SUB |
|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 |

LAMBDA

| | DEPRESSI | RUMINATI | HOST | SUB |
|---|---|---|---|---|
| DEPRESSI | 0 | 0 | 0 | 0 |
| RUMINATI | 0 | 0 | 0 | 0 |
| HOST | 0 | 0 | 0 | 0 |
| SUB | 0 | 0 | 0 | 0 |

THETA

| | DEPRESSI | RUMINATI | HOST | SUB |
|---|---|---|---|---|
| DEPRESSI | 0 | | | |
| RUMINATI | 0 | 0 | | |
| HOST | 0 | 0 | 0 | |
| SUB | 0 | 0 | 0 | 0 |

ALPHA

| | DEPRESSI | RUMINATI | HOST | SUB |
|---|---|---|---|---|
| 1 | 1 | 2 | 0 | 0 |

BETA

| | DEPRESSI | RUMINATI | HOST | SUB |
|---|---|---|---|---|
| DEPRESSI | 0 | 3 | 4 | 5 |
| RUMINATI | 0 | 0 | 6 | 7 |
| HOST | 0 | 0 | 0 | 0 |
| SUB | 0 | 0 | 0 | 0 |

PSI

| | DEPRESSI | RUMINATI | HOST | SUB |
|---|---|---|---|---|
| DEPRESSI | 8 | | | |
| RUMINATI | 0 | 9 | | |
| HOST | 0 | 0 | 0 | |
| SUB | 0 | 0 | 0 | 0 |

# Tech1

Here in the red boxes are the parameter numbers for The means of depression (1) And rumination (2)

TECHNICAL 1 OUTPUT

PARAMETER SPECIFICATION

NU

| | DEPRESSI | RUMINATI | HOST | SUB |
|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 |

LAMBDA

| | DEPRESSI | RUMINATI | HOST | SUB |
|---|---|---|---|---|
| DEPRESSI | 0 | 0 | 0 | 0 |
| RUMINATI | 0 | 0 | 0 | 0 |
| HOST | 0 | 0 | 0 | 0 |
| SUB | 0 | 0 | 0 | 0 |

THETA

| | DEPRESSI | RUMINATI | HOST | SUB |
|---|---|---|---|---|
| DEPRESSI | 0 | | | |
| RUMINATI | 0 | 0 | | |
| HOST | 0 | 0 | 0 | |
| SUB | 0 | 0 | 0 | 0 |

ALPHA

| | DEPRESSI | RUMINATI | HOST | SUB |
|---|---|---|---|---|
| 1 | 1 | 2 | 0 | 0 |

BETA

| | DEPRESSI | RUMINATI | HOST | SUB |
|---|---|---|---|---|
| DEPRESSI | 0 | 3 | 4 | 5 |
| RUMINATI | 0 | 0 | 6 | 7 |
| HOST | 0 | 0 | 0 | 0 |
| SUB | 0 | 0 | 0 | 0 |

PSI

| | DEPRESSI | RUMINATI | HOST | SUB |
|---|---|---|---|---|
| DEPRESSI | 8 | | | |
| RUMINATI | 0 | 9 | | |
| HOST | 0 | 0 | 0 | |
| SUB | 0 | 0 | 0 | 0 |

# Tech1

Here in the red box are the parameter numbers for The regression coefficients
With depression as the DV
i.e., 3, 4,5
And with rumination as the DV
i.e., 6, 7

TECHNICAL 1 OUTPUT

PARAMETER SPECIFICATION

NU

| | DEPRESSI | RUMINATI | HOST | SUB |
|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 |

LAMBDA

| | DEPRESSI | RUMINATI | HOST | SUB |
|---|---|---|---|---|
| DEPRESSI | 0 | 0 | 0 | 0 |
| RUMINATI | 0 | 0 | 0 | 0 |
| HOST | 0 | 0 | 0 | 0 |
| SUB | 0 | 0 | 0 | 0 |

THETA

| | DEPRESSI | RUMINATI | HOST | SUB |
|---|---|---|---|---|
| DEPRESSI | 0 | | | |
| RUMINATI | 0 | 0 | | |
| HOST | 0 | 0 | 0 | |
| SUB | 0 | 0 | 0 | 0 |

ALPHA

| | DEPRESSI | RUMINATI | HOST | SUB |
|---|---|---|---|---|
| 1 | 1 | 2 | 0 | 0 |

BETA

| | DEPRESSI | RUMINATI | HOST | SUB |
|---|---|---|---|---|
| DEPRESSI | 0 | 3 | 4 | 5 |
| RUMINATI | 0 | 0 | 6 | 7 |
| HOST | 0 | 0 | 0 | 0 |
| SUB | 0 | 0 | 0 | 0 |

PSI

| | DEPRESSI | RUMINATI | HOST | SUB |
|---|---|---|---|---|
| DEPRESSI | 8 | | | |
| RUMINATI | 0 | 9 | | |
| HOST | 0 | 0 | 0 | |
| SUB | 0 | 0 | 0 | 0 |

# Tech1

Here in the red box are the parameter numbers for Variance of depression (8) And the variance of Rumination (9)

TECHNICAL 1 OUTPUT

PARAMETER SPECIFICATION

NU

| | DEPRESSI | RUMINATI | HOST | SUB |
|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 0 |

LAMBDA

| | DEPRESSI | RUMINATI | HOST | SUB |
|---|---|---|---|---|
| DEPRESSI | 0 | 0 | 0 | 0 |
| RUMINATI | 0 | 0 | 0 | 0 |
| HOST | 0 | 0 | 0 | 0 |
| SUB | 0 | 0 | 0 | 0 |

THETA

| | DEPRESSI | RUMINATI | HOST | SUB |
|---|---|---|---|---|
| DEPRESSI | 0 | | | |
| RUMINATI | 0 | 0 | | |
| HOST | 0 | 0 | 0 | |
| SUB | 0 | 0 | 0 | 0 |

ALPHA

| | DEPRESSI | RUMINATI | HOST | SUB |
|---|---|---|---|---|
| 1 | 1 | 2 | 0 | 0 |

BETA

| | DEPRESSI | RUMINATI | HOST | SUB |
|---|---|---|---|---|
| DEPRESSI | 0 | 3 | 4 | 5 |
| RUMINATI | 0 | 0 | 6 | 7 |
| HOST | 0 | 0 | 0 | 0 |
| SUB | 0 | 0 | 0 | 0 |

PSI

| | DEPRESSI | RUMINATI | HOST | SUB |
|---|---|---|---|---|
| DEPRESSI | 8 | | | |
| RUMINATI | 0 | 9 | | |
| HOST | 0 | 0 | 0 | |
| SUB | 0 | 0 | 0 | 0 |

# Tech3 – Covariance Parameter Matrix

- Diagonals are the variances
- The body contains the covariances

# Tech3

Tech3 uses fortran notation
Which is a form of scientific
Notation

Examples:
0.212856D-02 = .002
(D-02 means add 2 leading 0s)

0.212856D+02 = 21.29
(D+02 means move the decimal
Over 2 spots)

TECHNICAL 3 OUTPUT

ESTIMATED COVARIANCE MATRIX FOR PARAMETER ESTIMATES

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| 1 | 0.212856D-02 | | | | |
| 2 | 0.359461D-19 | 0.211487D-02 | | | |
| 3 | 0.555058D-04 | -0.373083D-18 | 0.201151D-02 | | |
| 4 | -0.857395D-04 | -0.455727D-18 | -0.782207D-04 | 0.186539D-02 | |
| 5 | 0.131834D-04 | 0.229941D-17 | -0.183416D-03 | 0.107902D-03 | 0.199847D-02 |
| 6 | -0.142984D-18 | -0.831032D-04 | 0.448604D-16 | 0.307598D-16 | 0.200692D-17 |
| 7 | 0.266430D-17 | 0.181403D-04 | 0.144795D-15 | 0.795148D-16 | 0.207426D-15 |
| 8 | -0.208205D-07 | -0.372951D-19 | 0.378087D-07 | -0.519753D-07 | 0.599421D-07 |
| 9 | 0.275922D-17 | 0.473785D-07 | 0.108034D-15 | -0.542752D-17 | -0.339555D-16 |
| 10 | 0.216071D-05 | -0.166293D-03 | 0.783034D-04 | -0.304495D-05 | -0.713995D-05 |
| 11 | 0.505997D-05 | 0.362994D-04 | 0.183371D-03 | -0.713069D-05 | -0.167204D-04 |

ESTIMATED COVARIANCE MATRIX FOR PARAMETER ESTIMATES

| | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|
| 6 | 0.185170D-02 | | | | |
| 7 | 0.100194D-03 | 0.197042D-02 | | | |
| 8 | 0.186612D-17 | 0.413683D-17 | 0.450792D-02 | | |
| 9 | 0.173375D-06 | -0.933541D-07 | -0.228236D-17 | 0.445586D-02 | |
| 10 | 0.370531D-02 | 0.200491D-03 | 0.147180D-08 | 0.346929D-06 | 0.741751D-02 |
| 11 | 0.200491D-03 | 0.394288D-02 | 0.344668D-08 | -0.186805D-06 | 0.408329D-03 |

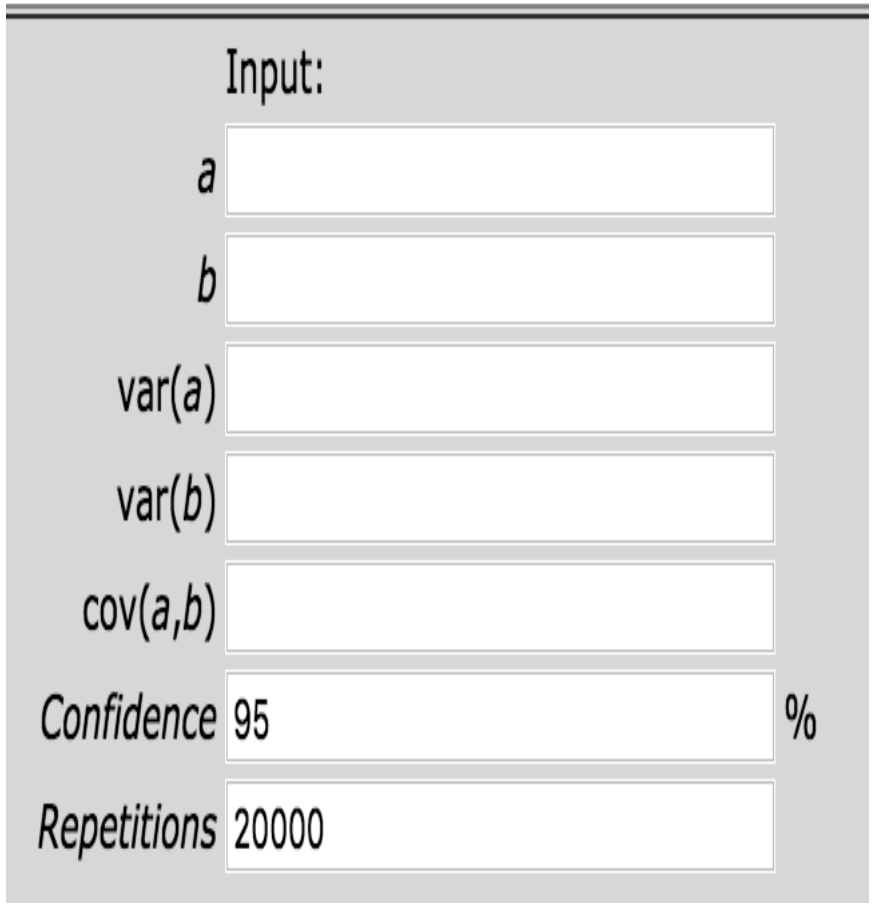
ESTIMATED COVARIANCE MATRIX FOR PARAMETER ESTIMATES

| | 11 |
|---|---|
| 11 | 0.790656D-02 |

# Now what did we want to do again?

- To make MCCIs we need:
- a and b come from the model results section
- Var(a), Var(b), and Cov(a,b) come from tech3

*Note: in the current model there are two indirect effects, so we have to do this twice



# a1, a2, b

MODEL RESULTS

| | Estimate | S.E. | Est./S.E. | Two-Tailed P-Value |
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| DEPRESSI ON | | | | |
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| RUMINATION | 1.055 | 0.067 | 15.811 | 0.000 |
| New/Additional Parameters | | | | |
| IND1 | 0.078 | 0.086 | 0.904 | 0.366 |
| IND2 | 0.182 | 0.089 | 2.051 | 0.040 |

# Steps

- Determine which parameter numbers go with the a-paths and b-paths
- Enter the estimates into the quantpsy calculator
- Look at the MCCI and see if it contains 0
  - If yes, then not significant
  - If no, then significant

# What parameters do we need?

- a1 is the regression slope of rumination on hostility
- a2 is the regression slope of rumination on substance use
- b is the regression slope of depression on rumination

*note only 1 b-path because rumination is the only mediator

- a1, a2, and b will come from the BETA matrix
- a1 is parameter 6, a2 is parameter 7, and b is parameter 3

BETA

| | DEPRESSI | RUMINATI | HOST | SUB |
|---|---|---|---|---|
| DEPRESSI | 0 | 3 | 4 | 5 |
| RUMINATI | 0 | 0 | 6 | 7 |
| HOST | 0 | 0 | 0 | 0 |
| SUB | 0 | 0 | 0 | 0 |

# Ok, back to tech3

- Var(a1) =
  - Parameter 6 with 6
  - .0019
- Var(a2) =
  - Parameter 7 with 7
  - .00197
- Var(b) =
  - Parameter 3 with 3
  - .002
- Cov(a1,b) =
  - Parameter 6 with 3
  - .00000000000000004
- Cov(a2, b) =
  - Parameter 7 with 3
  - .0000000000000001

TECHNICAL 3 OUTPUT

ESTIMATED COVARIANCE MATRIX FOR PARAMETER ESTIMATES

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| 1 | 0.212856D-02 | | | | |
| 2 | 0.359461D-19 | 0.211487D-02 | | | |
| 3 | 0.555058D-04 | -0.373083D-18 | 0.201151D-02 | | |
| 4 | -0.857395D-04 | -0.455727D-18 | -0.782207D-04 | 0.186539D-02 | |
| 5 | 0.131834D-04 | 0.229941D-17 | -0.183416D-03 | 0.107902D-03 | 0.199847D-02 |
| 6 | -0.142984D-18 | -0.831032D-04 | 0.448604D-16 | 0.307598D-16 | 0.200692D-17 |
| 7 | 0.266430D-17 | 0.181403D-04 | 0.144795D-15 | 0.795148D-16 | 0.207426D-15 |
| 8 | -0.208205D-07 | -0.372951D-19 | 0.378087D-07 | -0.519753D-07 | 0.599421D-07 |
| 9 | 0.275922D-17 | 0.473785D-07 | 0.108034D-15 | -0.542752D-17 | -0.339555D-16 |
| 10 | 0.216071D-05 | -0.166293D-03 | 0.783034D-04 | -0.304495D-05 | -0.713995D-05 |
| 11 | 0.505997D-05 | 0.362994D-04 | 0.183371D-03 | -0.713069D-05 | -0.167204D-04 |

ESTIMATED COVARIANCE MATRIX FOR PARAMETER ESTIMATES

| | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|
| 6 | 0.185170D-02 | | | | |
| 7 | 0.100194D-03 | 0.197042D-02 | | | |
| 8 | 0.186612D-17 | 0.413683D-17 | 0.450792D-02 | | |
| 9 | 0.173375D-06 | -0.933541D-07 | -0.228236D-17 | 0.445586D-02 | |
| 10 | 0.370531D-02 | 0.200491D-03 | 0.147180D-08 | 0.346929D-06 | 0.741751D-02 |
| 11 | 0.200491D-03 | 0.394288D-02 | 0.344668D-08 | -0.186805D-06 | 0.408329D-03 |

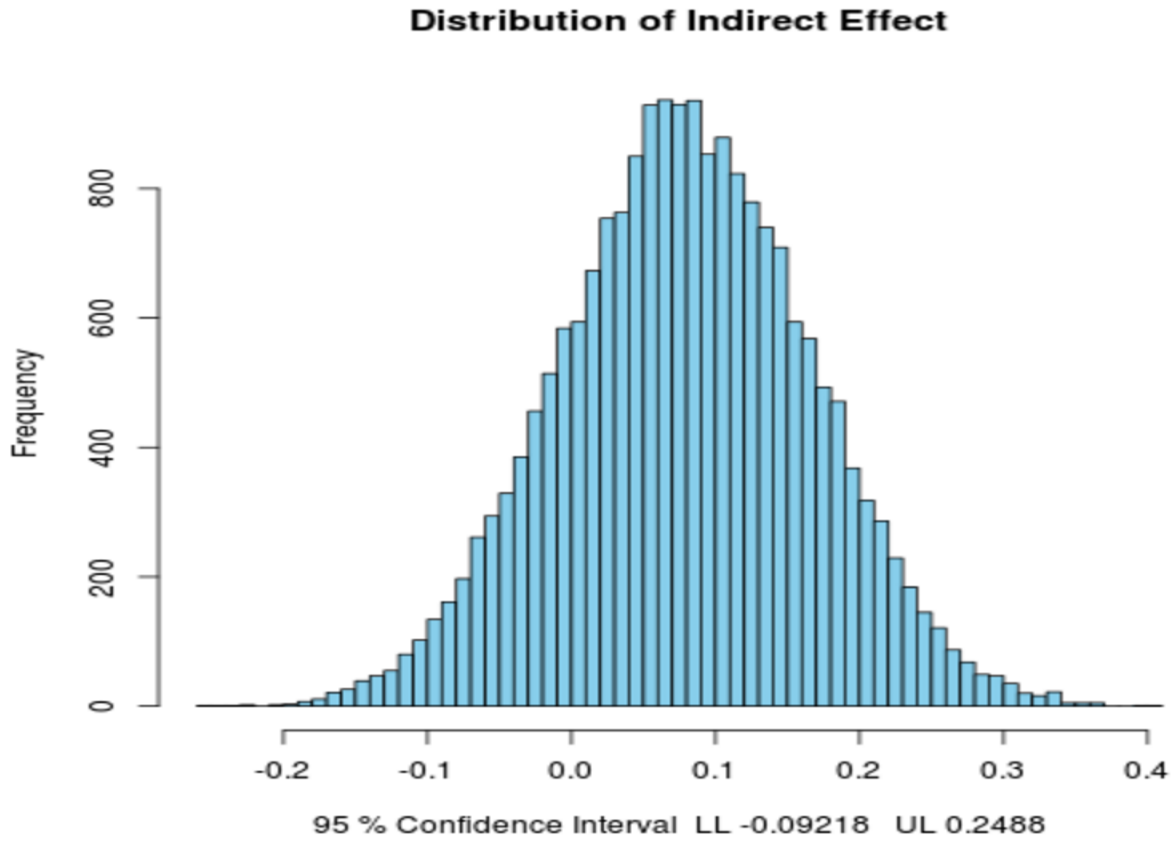
ESTIMATED COVARIANCE MATRIX FOR PARAMETER ESTIMATES

| | 11 |
|---|---|
| 11 | 0.790656D-02 |

# Time to calculate our first MCCI

- Hostility→Rumination→Depression
- a1*b
- MCCI = [-.09, .24] not sig.

| Input: | | |
|---|---|---|
| *a* | .039 | |
| *b* | 2.001 | |
| var(*a*) | .0019 | |
| var(*b*) | .002 | |
| cov(*a*,*b*) | .00000000000000004 | |
| *Confidence* | 95 | % |
| *Repetitions* | 20000 | |



# Time to calculate our second MCCI

- Substance Use→Rumination→Depression
- a2*b
- MCCI = [.005, .36] significant

| Input: | | |
|---|---|---|
| *a* | .091 | |
| *b* | 2.001 | |
| var(*a*) | .00197 | |
| var(*b*) | .002 | |
| cov(*a*,*b*) | .0000000000000001 | |
| *Confidence* | 95 | % |
| *Repetitions* | 20000 | |