R Workshop: Mediation and Moderation

Brier Gallihugh, M.S.

2023-06-19

Table of contents


```
set.seed(10311993)
library(mediation)
library(psych)
library(tidyverse)

# Created Toy Data Set
# Variance Covariance
sigma <- rbind(c(1,-0.4,-0.3), c(-0.4,1, 0.7), c(-0.3,0.7,1))
# Variable Mean
mu <- c(7, 50, 7)
# Generate the Multivariate Normal Distribution
df <- as.data.frame(mvrnorm(n=100, mu=mu, Sigma=sigma))
df <- round(df,0)
colnames(df) <- c("mediator1","outcome","predictor")
df$condition <- rep(1:2,50)
```

Running a Moderation Analysis in R

```r
moderation <- lm(outcome ~ condition*predictor, data = df)   # (1)
summary(moderation)                                          # (2)
```

(1) Create a mediation object using the `lm()` function. The condition*predictor syntax gets you both the main effects of condition and predictor as well as the interaction effect between the two

(2) Show a summary of the moderation using the `summary()` function.

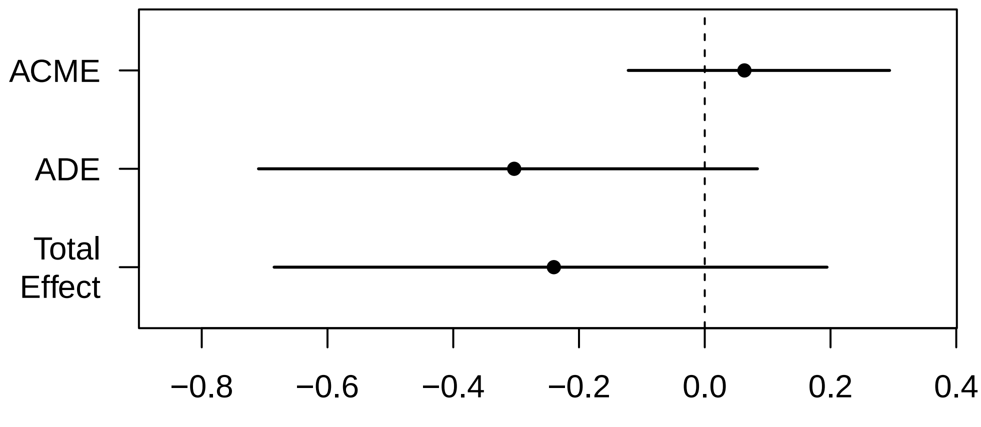
```
Call:
lm(formula = outcome ~ condition * predictor, data = df)

Residuals:
     Min       1Q   Median       3Q      Max 
-1.79555 -0.56073 -0.05061  0.55043  1.71457 

Coefficients:
                    Estimate Std. Error t value Pr(>|t|)    
(Intercept)         44.85018    1.68125  26.677  < 2e-16 ***
condition           -0.01414    1.06533  -0.013  0.98943    
predictor            0.76026    0.23452   3.242  0.00163 ** 
condition:predictor -0.01533    0.14964  -0.102  0.91864    
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.8027 on 96 degrees of freedom
Multiple R-squared:  0.5089,	Adjusted R-squared:  0.4936 
F-statistic: 33.16 on 3 and 96 DF,  p-value: 8.49e-15
```

Running a Mediation Analysis in R

```r
#Regress M on X
outcomeM_fit <- lm(mediator1 ~ condition, data = df)              # (1)
summary(outcomeM_fit)                                             # (2)

#Regress Y on M and X
outcomeY_fit <- lm(outcome ~ mediator1 + condition, data = df)    # (3)
summary(outcomeY_fit)                                             # (4)
```

```r
#Run Mediation with Bootstrap
outcome_fit <- mediation::mediate(outcomeM_fit,
                                  outcomeY_fit,
                                  treat = "condition",
                                  mediator = "mediator1",
                                  boot = TRUE,
                                  sims = 5000)
#Summary of Mediation
summary(outcome_fit)

#Path Coefficients
plot(outcome_fit)
```

(1) Run a regression of the M (mediator) on X using the `lm()` function
(2) Show output of the M on X regression using the `summary()` function
(3) Run a regression of Y on M and X using the `lm()` function
(4) Show output of the Y on M and X regression using the `summary()` function
(5) Run a mediation using the two regressions above. `treat` is the name of your X condition. `mediator` is the name of your mediating variable. Setting `boot` to `TRUE` will ensure that your mediation is bootstrapped. Lastly, the `sims` argument tells R how many samples you wish to bootstrap from. Typically you want ~ 5000 or more.
(6) For a summary of your mediation, use the `summary()` function. The indirect effect is labeled ACME
(7) The `plot()` function here will give you a graphical representation of the output above with respect to the range of the confidence interval for each metric. Please note by default this is the 95% confidence interval




```
Call:
lm(formula = mediator1 ~ condition, data = df)

Residuals:
   Min     1Q Median     3Q    Max
-2.860 -0.755  0.140  1.140  2.280

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   7.0000     0.3412  20.515   <2e-16 ***
condition    -0.1400     0.2158  -0.649    0.518
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1.079 on 98 degrees of freedom
Multiple R-squared:  0.004276,	Adjusted R-squared:  -0.005884
F-statistic: 0.4209 on 1 and 98 DF,  p-value: 0.518


Call:
lm(formula = outcome ~ mediator1 + condition, data = df)

Residuals:
```

```
    Min      1Q  Median      3Q     Max 
-2.2245 -0.5522 -0.0769  0.4724  3.4724 

Coefficients:
            Estimate Std. Error t value Pr(>|t|)    
(Intercept) 53.53460    0.74376  71.979  < 2e-16 ***
mediator1   -0.45066    0.09569  -4.709 8.28e-06 ***
condition   -0.30309    0.20487  -1.479    0.142    
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1.022 on 97 degrees of freedom
Multiple R-squared:  0.1954,	Adjusted R-squared:  0.1788 
F-statistic: 11.78 on 2 and 97 DF,  p-value: 2.634e-05


Causal Mediation Analysis 

Nonparametric Bootstrap Confidence Intervals with the Percentile Method

               Estimate 95% CI Lower 95% CI Upper p-value
ACME             0.0631      -0.1217         0.29    0.52
ADE             -0.3031      -0.7098         0.08    0.12
Total Effect    -0.2400      -0.6849         0.19    0.28
Prop. Mediated  -0.2629      -6.0955         4.66    0.76

Sample Size Used: 100 


Simulations: 5000 
```

Assumptions of Moderation Analyses

```r
# Residual Normality
shapiro.test(residuals(moderation))                                    ①

# Multicollinearity
car::vif(moderation, type = c("predictor"))                            ②

# Independence of Errors
car::durbinWatsonTest(moderation)                                      ③
```

① Test of the residual normality of the moderation using the `shapiro.test()` function

② Test of the multicollinearity of the moderation analyses using the `vif()` function in the `car` package. Because there is an interaction, you must specify an additional argument of `type = c("predictor")` to properly account for the interaction effect.

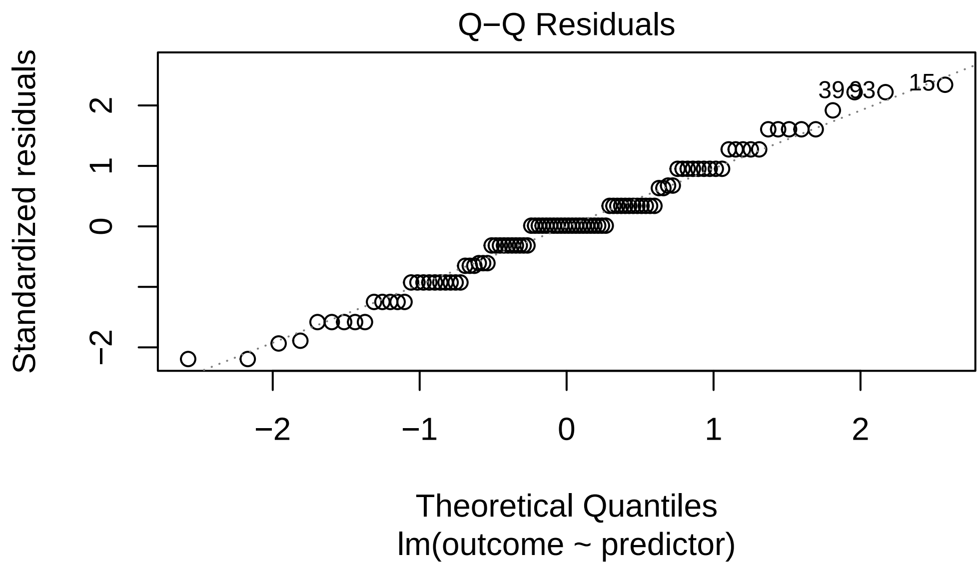
③ To test the independence of errors assumption, you can do so using the `durbinWatsonTest()` function from the `car` package.

```
    Shapiro-Wilk normality test

data:  residuals(moderation)
W = 0.98684, p-value = 0.4272

          GVIF Df GVIF^(1/(2*Df)) Interacts With Other Predictors
condition    1  3               1      predictor              --
predictor    1  3               1      condition              --
 lag Autocorrelation D-W Statistic p-value
   1     -0.02268275      2.029087   0.756
 Alternative hypothesis: rho != 0
```

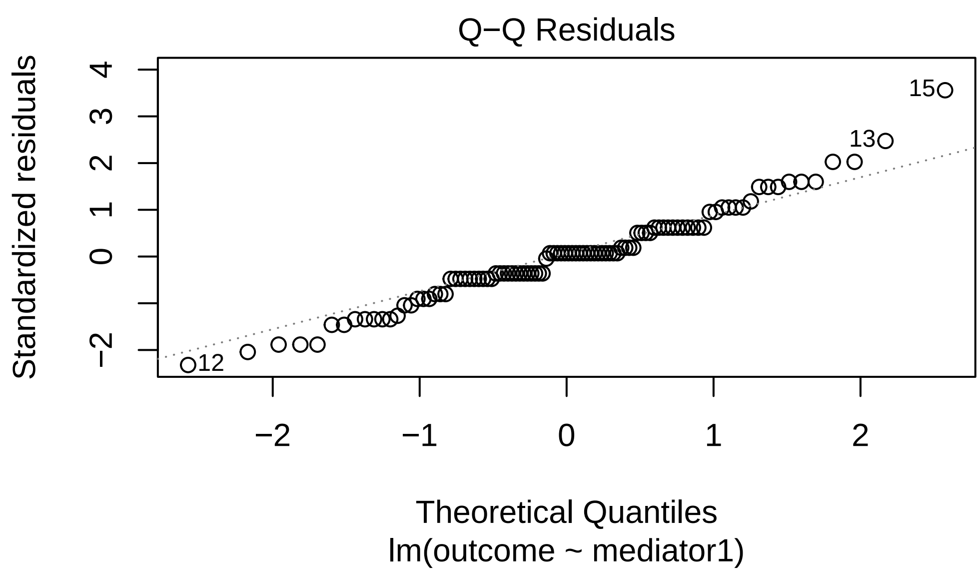
Assumptions of Mediation Analyses

```r
# Linearity
plot(lm(outcome ~ predictor, data = df),2)     ①
```

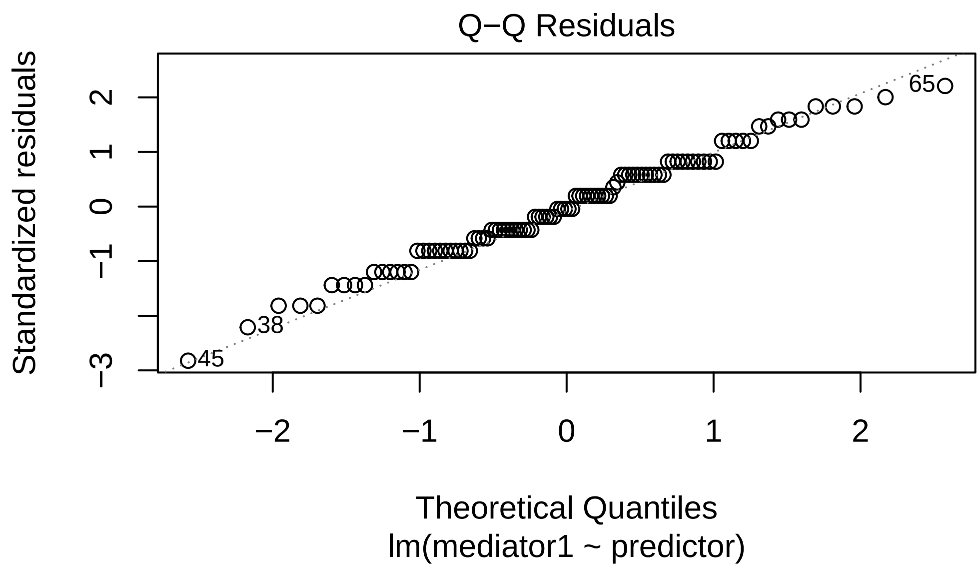
② To assess multicollinearity, the best course of action is a simple correlation matrix. You can achieve this using the `cor()` function for a correlation matrix




```
plot(lm(outcome ~ mediator1, data = df),2)
```
①



```r
plot(lm(mediator1 ~ predictor, data = df),2)
```
①




```r
# Multicollinearity
cor(df)
```
②

```
           mediator1    outcome   predictor   condition
mediator1  1.00000000 -0.4210068 -0.38328907 -0.06539201
outcome   -0.42100683  1.0000000  0.71129322 -0.10692147
predictor -0.38328907  0.7112932  1.00000000 -0.07432941
condition -0.06539201 -0.1069215 -0.07432941  1.00000000
```

Using Moderation and Mediation Usings Hayes PROCESS Macro (for R)

Click on the following link to download the R script for the PROCESS macro for R.

```r
source("process.R")
```

```
******************** PROCESS for R Version 4.3.1 ********************
```

```
          Written by Andrew F. Hayes, Ph.D.  www.afhayes.com
   Documentation available in Hayes (2022). www.guilford.com/p/hayes3

***********************************************************************

PROCESS is now ready for use.
Copyright 2020-2023 by Andrew F. Hayes ALL RIGHTS RESERVED
Workshop schedule at http://haskayne.ucalgary.ca/CCRAM
```

A Moderation Example Using Hayes PROCESS Macro

```
process(data = df,          # (1)
        y = "outcome",      # (2)
        x = "predictor",    # (3)
        w = "mediator1",    # (4)
        model = 1,          # (5)
        stand = 1)          # (6)
```

(1) Assign your data to the `data` argument
(2) Assign your outcome variable to the `y` argument
(3) Assign your predictor variable to the `x` argument
(4) Assign your moderator to the `w` argument
(5) Set your `model` argument to `1` for simple moderation
(6) The `stand = 1` argument standardizes your output

```
******************** PROCESS for R Version 4.3.1 ********************

          Written by Andrew F. Hayes, Ph.D.  www.afhayes.com
   Documentation available in Hayes (2022). www.guilford.com/p/hayes3

***********************************************************************

Model : 1
    Y : outcome
    X : predictor
    W : mediator1

Sample size: 100
```

```
***********************************************************************
Outcome Variable: outcome

Model Summary:
          R       R-sq        MSE          F        df1        df2          p
     0.7294     0.5320     0.6141    36.3739     3.0000    96.0000     0.0000

Model:
              coeff         se          t          p       LLCI       ULCI
constant    47.3198     3.6872    12.8336     0.0000    40.0008    54.6389
predictor    0.5567     0.5256     1.0592     0.2922    -0.4866     1.6001
mediator1   -0.2975     0.5240    -0.5676     0.5716    -1.3377     0.7427
Int_1        0.0169     0.0761     0.2222     0.8246    -0.1341     0.1679

Product terms key:
Int_1   :  predictor  x  mediator1

Test(s) of highest order unconditional interaction(s):
      R2-chng          F        df1        df2          p
X*W    0.0002     0.0494     1.0000    96.0000     0.8246

******************** ANALYSIS NOTES AND ERRORS ************************

Level of confidence for all confidence intervals in output: 95

NOTE: Standardized coefficients not available for models with moderators.
```

Tip

The Hayes PROCESS for R requires that all data is numeric in nature. As such, ensure that any potential factor variables are numeric prior to running the analyses. A failure to do so will result in PROCESS not running.

A Mediation Example Using Hayes PROCESS Macro

```
process(data = df,                                                    ①
        y = "outcome",                                                ②
        x = "predictor",                                              ③
        m = "mediator1",                                              ④
        model = 4,                                                    ⑤
```

```r
         stand = 1,                                              # 6
         boot = 5000)                                            # 7
```

① Assign your data to the `data` argument
② Assign your outcome variable to the `y` argument
③ Assign your predictor variable to the `x` argument
④ Assign your mediator to the `m` argument
⑤ Set your `model` argument to `4` for simple mediation
⑥ The `stand = 1` argument standardizes your output
⑦ The `boot` argument specifies the number of samples you wish to bootstrap

```
********************* PROCESS for R Version 4.3.1 *********************

           Written by Andrew F. Hayes, Ph.D.  www.afhayes.com
   Documentation available in Hayes (2022). www.guilford.com/p/hayes3

***********************************************************************

Model : 4
    Y : outcome
    X : predictor
    M : mediator1

Sample size: 100

Random seed: 818206


***********************************************************************
Outcome Variable: mediator1

Model Summary:
          R       R-sq        MSE          F        df1        df2          p
     0.3833     0.1469     0.9975    16.8766     1.0000    98.0000     0.0001

Model:
              coeff         se          t          p       LLCI       ULCI
constant     9.4738     0.6609    14.3352     0.0000     8.1623    10.7852
predictor   -0.3812     0.0928    -4.1081     0.0001    -0.5654    -0.1971

Standardized coefficients:
              coeff
```

```
predictor   -0.3833

**************************************************************************
Outcome Variable: outcome

Model Summary:
          R      R-sq       MSE         F       df1       df2         p
     0.7292    0.5317    0.6081   55.0760    2.0000   97.0000    0.0000

Model:
              coeff        se         t         p      LLCI      ULCI
constant    46.5259    0.9080   51.2386    0.0000   44.7237   48.3281
predictor    0.6722    0.0784    8.5694    0.0000    0.5165    0.8279
mediator1   -0.1824    0.0789   -2.3121    0.0229   -0.3389   -0.0258

Standardized coefficients:
              coeff
predictor    0.6446
mediator1   -0.1740

**************************************************************************
Bootstrapping progress:

  |
  |                                                            |   0%
  |
  |                                                            |   1%
  |
  |>                                                           |   1%
  |
  |>                                                           |   2%
  |
  |>>                                                          |   2%
  |
  |>>                                                          |   3%
  |
  |>>                                                          |   4%
  |
  |>>>                                                         |   4%
  |
  |>>>                                                         |   5%
  |
  |>>>                                                         |   6%
```

```
|
|>>>>                                                                  |   6%
|
|>>>>                                                                  |   7%
|
|>>>>>                                                                 |   7%
|
|>>>>>                                                                 |   8%
|
|>>>>>                                                                 |   9%
|
|>>>>>>                                                                |   9%
|
|>>>>>>                                                                |  10%
|
|>>>>>>>                                                               |  10%
|
|>>>>>>>                                                               |  11%
|
|>>>>>>>                                                               |  12%
|
|>>>>>>>>                                                              |  12%
|
|>>>>>>>>                                                              |  13%
|
|>>>>>>>>                                                              |  14%
|
|>>>>>>>>>                                                             |  14%
|
|>>>>>>>>>                                                             |  15%
|
|>>>>>>>>>>                                                            |  15%
|
|>>>>>>>>>>                                                            |  16%
|
|>>>>>>>>>>                                                            |  17%
|
|>>>>>>>>>>>                                                           |  17%
|
|>>>>>>>>>>>                                                           |  18%
|
|>>>>>>>>>>>                                                           |  19%
|
```

```
|>>>>>>>>>>>>                                                      |  19%
|
|>>>>>>>>>>>>                                                      |  20%
|
|>>>>>>>>>>>>>                                                     |  20%
|
|>>>>>>>>>>>>>                                                     |  21%
|
|>>>>>>>>>>>>>                                                     |  22%
|
|>>>>>>>>>>>>>>                                                    |  22%
|
|>>>>>>>>>>>>>>                                                    |  23%
|
|>>>>>>>>>>>>>>>                                                   |  23%
|
|>>>>>>>>>>>>>>>                                                   |  24%
|
|>>>>>>>>>>>>>>>                                                   |  25%
|
|>>>>>>>>>>>>>>>>                                                  |  25%
|
|>>>>>>>>>>>>>>>>                                                  |  26%
|
|>>>>>>>>>>>>>>>>                                                  |  27%
|
|>>>>>>>>>>>>>>>>>                                                 |  27%
|
|>>>>>>>>>>>>>>>>>                                                 |  28%
|
|>>>>>>>>>>>>>>>>>>                                                |  28%
|
|>>>>>>>>>>>>>>>>>>                                                |  29%
|
|>>>>>>>>>>>>>>>>>>                                                |  30%
|
|>>>>>>>>>>>>>>>>>>>                                               |  30%
|
|>>>>>>>>>>>>>>>>>>>                                               |  31%
|
|>>>>>>>>>>>>>>>>>>>>                                              |  31%
|
|>>>>>>>>>>>>>>>>>>>>                                              |  32%
```

```
|
|>>>>>>>>>>>>>>>>>>>>                                                          |  33%
|
|>>>>>>>>>>>>>>>>>>>>>                                                         |  33%
|
|>>>>>>>>>>>>>>>>>>>>>                                                         |  34%
|
|>>>>>>>>>>>>>>>>>>>>>                                                         |  35%
|
|>>>>>>>>>>>>>>>>>>>>>>                                                        |  35%
|
|>>>>>>>>>>>>>>>>>>>>>>                                                        |  36%
|
|>>>>>>>>>>>>>>>>>>>>>>>                                                       |  36%
|
|>>>>>>>>>>>>>>>>>>>>>>>                                                       |  37%
|
|>>>>>>>>>>>>>>>>>>>>>>>                                                       |  38%
|
|>>>>>>>>>>>>>>>>>>>>>>>>                                                      |  38%
|
|>>>>>>>>>>>>>>>>>>>>>>>>                                                      |  39%
|
|>>>>>>>>>>>>>>>>>>>>>>>>                                                      |  40%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>                                                     |  40%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>                                                     |  41%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>                                                    |  41%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>                                                    |  42%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>                                                    |  43%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>                                                   |  43%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>                                                   |  44%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>                                                  |  44%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>                                                  |  45%
|
```

```
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>                                  |  46%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                                 |  46%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                                 |  47%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                                 |  48%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                                |  48%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                                |  49%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                               |  49%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                               |  50%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                               |  51%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                              |  51%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                              |  52%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                             |  52%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                             |  53%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                             |  54%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                            |  54%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                            |  55%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                            |  56%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                           |  56%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                           |  57%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                          |  57%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                          |  58%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                          |  59%
```

```
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                         |  59%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                         |  60%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                        |  60%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                        |  61%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                        |  62%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                       |  62%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                       |  63%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                       |  64%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                      |  64%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                      |  65%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                     |  65%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                     |  66%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                     |  67%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                    |  67%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                    |  68%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                    |  69%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                   |  69%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                   |  70%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                  |  70%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                  |  71%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                  |  72%
|
```

```
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                | 72%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>                | 73%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>               | 73%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>               | 74%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>               | 75%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>              | 75%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>              | 76%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>              | 77%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>             | 77%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>             | 78%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>            | 78%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>            | 79%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>            | 80%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>           | 80%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>           | 81%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>          | 81%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>          | 82%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>          | 83%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>         | 83%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>         | 84%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>         | 85%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>        | 85%
```

```
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>          |  86%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>         |  86%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>         |  87%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>         |  88%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>        |  88%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>        |  89%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>        |  90%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>       |  90%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>       |  91%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>      |  91%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>      |  92%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>      |  93%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>     |  93%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>     |  94%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>    |  94%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>    |  95%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>    |  96%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>   |  96%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>   |  97%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>   |  98%
|
|>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>  |  98%
|
```

```
  |>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>> |  99%
  |
  |>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>|  99%
  |
  |>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>| 100%

**************** DIRECT AND INDIRECT EFFECTS OF X ON Y ****************

Direct effect of X on Y:
     effect         se          t          p       LLCI       ULCI      c'_cs
     0.6722     0.0784     8.5694     0.0000     0.5165     0.8279     0.6446

Indirect effect(s) of X on Y:
             Effect    BootSE  BootLLCI  BootULCI
mediator1    0.0695    0.0353    0.0100    0.1483

Completely standardized indirect effect(s) of X on Y:
             Effect    BootSE  BootLLCI  BootULCI
mediator1    0.0667    0.0339    0.0097    0.1436

******************** ANALYSIS NOTES AND ERRORS ************************

Level of confidence for all confidence intervals in output: 95

Number of bootstraps for percentile bootstrap confidence intervals: 5000
```