Single Mediator Model Example - - SPSS, SAS, and MPlus Handouts

This handout provides the SPSS, SAS, and MPlus syntax and outputs for the single mediator model water consumption example in MacKinnon (2008) Chapter 3.

Four variables are defined: (a) subject ID #, (b) room temperature, or subject score on X, (c) reported thirst, or subject score on M, and (d) water consumption, or subject score on Y.

SPSS

Syntax:

```
data list
 /ID X M Y.
begin data.
 1   70   4   3
 2   71   4   3
 3   69   1   3
 4   70   1   3
 5   71   3   3
 6   70   4   2
 7   69   3   3
 8   70   5   5
 9   70   4   4
10   72   5   4
11   71   2   2
12   71   3   4
13   70   5   5
14   71   4   5
15   71   4   5
16   70   2   2
17   70   4   4
18   69   3   5
19   72   3   4
20   71   3   3
21   71   2   4
22   72   3   5
23   67   1   2
24   71   4   4
25   71   3   2
26   70   3   4
27   70   2   3
28   69   3   4
29   69   4   3
```

```
30   70   3   3
31   71   2   1
32   70   1   3
33   70   2   5
34   70   2   1
35   71   4   3
36   68   2   1
37   72   4   3
38   69   3   2
39   70   3   3
40   68   3   2
41   68   3   3
42   70   4   3
43   71   4   4
44   69   2   2
45   69   3   3
46   71   3   4
47   71   4   4
48   71   3   2
49   72   4   5
50   70   2   2
end data.
list.
execute.

* The following commands run the three mediation regression equations
  outlined in Chapter 3 for the water consumption example.

* STEP 1:
        Regress the outcome variable on the IV. That is, regress
        water consumption on room temperature.
regression
 /variables X Y M
 /dependent=Y
 /enter=X.

* STEP 2:
        Regress the outcome variable on the IV and the mediator. That
        is, regress water consumption on room temperature and thirst.
regression
 /variables X Y M
 /dependent=Y
 /enter=X M.

* STEP 3:
        Regress the mediator on the IV. That is, regress thirst on room
```

temperature.
regression
/variables X Y M
/dependent=M
/enter=X.

execute.

SPSS Output:

```
Number of cases read:  50    Number of cases listed:  50


* The following commands run the three mediation regression equations
  outlined in Chapter 3 for the water consumption example.

* STEP 1:
 Regress the outcome variable on the IV. That is, regress
   water consumption on room temperature.
regression
 /variables X Y M
 /dependent=Y
 /enter=X.
```

Regression

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	X[a]	.	Enter

a. All requested variables entered.

b. Dependent Variable: Y

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.361[a]	.130	.112	1.06936

a. Predictors: (Constant), X

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	8.231	1	8.231	7.198	.010[a]
	Residual	54.889	48	1.144		
	Total	63.120	49			

a. Predictors: (Constant), X

b. Dependent Variable: Y

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-22.050	9.428		-2.339	.024
	X	.360	.134	.361	2.683	.010

a. Dependent Variable: Y

i_1 $\hat{c}$

$$Y = -22.050 + .360\ X \quad (.134)$$

```
* STEP 2:
 Regress the outcome variable on the IV and the mediator. That
   is, regress water consumption on room temperature and thirst.
regression
 /variables X Y M
 /dependent=Y
 /enter=X M.
```

Regression

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	M, X[a]	.	Enter

a. All requested variables entered.

b. Dependent Variable: Y

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.527[a]	.277	.246	.98523

a. Predictors: (Constant), M, X

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	17.498	2	8.749	9.013	.000[a]
	Residual	45.622	47	.971		
	Total	63.120	49			

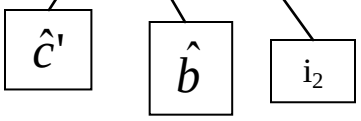
a. Predictors: (Constant), M, X

b. Dependent Variable: Y

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-12.713	9.197		-1.382	.173
	X	.208	.133	.208	1.558	.126
	M	.451	.146	.413	3.090	.003

Dependent Variable: Y



$$Y = -12.713 + .208\,X + .451\,M$$
$$(.133) \quad (.146)$$

```
* STEP 3:
 Regress the mediator on the IV. That is, regress thirst on room
   temperature.
regression
 /variables X Y M
 /dependent=M
 /enter=X.
```

Regression

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	X[a]	.	Enter

a. All requested variables entered.

b. Dependent Variable: M

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.371[a]	.138	.120	.97419

a. Predictors: (Constant), X

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	7.266	1	7.266	7.656	.008[a]
	Residual	45.554	48	.949		
	Total	52.820	49			

a. Predictors: (Constant), X

b. Dependent Variable: M

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-20.702	8.589		-2.410	.020
	X	.339	.122	.371	2.767	.008

a. Dependent Variable: M

$\hat{a}$ i_3

M = -20.702 + .339 X
(.122)

SAS

Syntax:

```
title 'Chapter 3 Analysis Example- Single Mediator Model';

data a;
input  id x m y;
 cards;
 1    70    4    3
 2    71    4    3
 3    69    1    3
 4    70    1    3
 5    71    3    3
 6    70    4    2
 7    69    3    3
 8    70    5    5
 9    70    4    4
10    72    5    4
11    71    2    2
12    71    3    4
13    70    5    5
14    71    4    5
15    71    4    5
16    70    2    2
17    70    4    4
18    69    3    5
19    72    3    4
20    71    3    3
21    71    2    4
22    72    3    5
23    67    1    2
24    71    4    4
25    71    3    2
26    70    3    4
27    70    2    3
28    69    3    4
29    69    4    3
30    70    3    3
31    71    2    1
32    70    1    3
33    70    2    5
34    70    2    1
35    71    4    3
36    68    2    1
37    72    4    3
38    69    3    2
39    70    3    3
40    68    3    2
41    68    3    3
42    70    4    3
43    71    4    4
44    69    2    2
45    69    3    3
46    71    3    4
47    71    4    4
```

```
48     71     3     2
49     72     4     5
50     70     2     2
;
* The following commands run the three mediation regression
  equations outlined in Chapter 3 for the water consumption
  example;

/* Equation 3.1:
            Regress the outcome variable on the IV. That is, regress
            water consumption on room temperature. */
      proc reg;
      model y=x;

/* Equation 3.2:
            Regress the outcome variable on the IV and the
            mediator. That is, regress water consumption on room
            temperature and thirst. */
      proc reg;
      model y=x m;

/* Equation 3.3:
            Regress the mediator on the IV. That is, regress thirst
            on room temperature. */
      proc reg;
      model m=x;

run;
```

SAS Output:

Chapter 3 Analysis Example- Single Mediator Model

The REG Procedure
Model: MODEL1
Dependent Variable: y

Number of Observations Read	50
Number of Observations Used	50

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	8.23076	8.23076	7.20	0.0100
Error	48	54.88924	1.14353		
Corrected Total	49	63.12000			

Root MSE	1.06936	R-Square	0.1304
Dependent Mean	3.24000	Adj R-Sq	0.1123
Coeff Var	33.00487		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-22.05049	9.42792	-2.34	0.0236
x	1	0.36037	0.13432	2.68	0.0100

i_1 $\hat{c}$

$$Y = -22.05 + .360\ X$$
$$(.134)$$

The REG Procedure
Model: MODEL1
Dependent Variable: y

Number of Observations Read	50
Number of Observations Used	50

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	17.49805	8.74903	9.01	0.0005
Error	47	45.62195	0.97068		
Corrected Total	49	63.12000			

Root MSE	0.98523	R-Square	0.2772
Dependent Mean	3.24000	Adj R-Sq	0.2465
Coeff Var	30.40836		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-12.71288	9.19691	-1.38	0.1734
x	1	0.20765	0.13326	1.56	0.1259
m	1	0.45104	0.14597	3.09	0.0034

$\hat{c}'$ $\hat{b}$ i_2

$$Y = -12.713 + .208\ X + .451\ M$$
$$(.133) \quad (.146)$$

The REG Procedure
Model: MODEL1
Dependent Variable: m

Number of Observations Read 50
Number of Observations Used 50

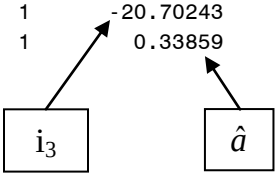
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	7.26620	7.26620	7.66	0.0080
Error	48	45.55380	0.94904		
Corrected Total	49	52.82000			

Root MSE	0.97419	R-Square	0.1376
Dependent Mean	3.06000	Adj R-Sq	0.1196
Coeff Var	31.83613		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-20.70243	8.58885	-2.41	0.0198
x	1	0.33859	0.12237	2.77	0.0080



$$M = -20.702 + .339\,X \quad (.122)$$

MPlus

Syntax:

```
TITLE: Ch:3 Book Data Single Mediator Model Example;

 DATA:
      File is 'ch3data.txt';

 VARIABLE:
      Names are s x m y;
      Usevariables are x m y;

MODEL:
      m on x;
      y on m x;
 MODEL INDIRECT:
      y ind x;

OUTPUT:
cinterval;
```

MPlus Output:

INPUT READING TERMINATED NORMALLY

Book Data Single Mediator Model Example;

SUMMARY OF ANALYSIS

Number of groups	1
Number of observations	50
Number of dependent variables	2
Number of independent variables	1
Number of continuous latent variables	0

Observed dependent variables

Continuous	
M	Y

Observed independent variables

X

Estimator ML
Information matrix OBSERVED
Maximum number of iterations 1000
Convergence criterion 0.500D-04
Maximum number of steepest descent iterations 20

Input data file(s)
ch3data.txt

THE MODEL ESTIMATION TERMINATED NORMALLY

TESTS OF MODEL FIT

Chi-Square Test of Model Fit
Value 0.000
Degrees of Freedom 0
P-Value 0.0000

Chi-Square Test of Model Fit for the Baseline Model
Value 23.632
Degrees of Freedom 3
P-Value 0.0000

CFI/TLI
CFI 1.000
TLI 1.000

Loglikelihood
H0 Value -214.150
H1 Value -214.150

Information Criteria
Number of Free Parameters 7
Akaike (AIC) 442.300
Bayesian (BIC) 455.684
Sample-Size Adjusted BIC 433.712
(n* = (n + 2) / 24)
RMSEA (Root Mean Square Error Of Approximation)
Estimate 0.000
90 Percent C.I. 0.000 0.000
Probability RMSEA <= .05 0.000

SRMR (Standardized Root Mean Square Residual)
Value 0.000

MODEL RESULTS

		Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
M ON					
X	$\hat{a}$ →	0.339	0.120	2.824	0.005
Y ON					
M	$\hat{b}$ →	0.451	0.142	3.187	0.001
X	$\hat{c}'$ →	0.208	0.129	1.607	0.108
Intercepts					
M	i_3 →	-20.702	8.415	-2.460	0.014
Y	i_2 →	-12.713	8.917	-1.426	0.154
Residual Variances					
M	$s^2_{\hat{e}_3}$ →	0.911	0.182	5.000	0.000
Y	$s^2_{\hat{e}_2}$ →	0.912	0.182	5.000	0.000

TOTAL, TOTAL INDIRECT, SPECIFIC INDIRECT, AND DIRECT EFFECTS

		Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
Effects from X to Y					
Total	$\hat{a}\hat{b} + \hat{c}'$ →	0.360	0.132	2.738	0.006
Total indirect	$\hat{a}\hat{b}$ →	0.153	0.072	2.114	0.035
Specific indirect					
Y M X	$\hat{a}\hat{b}$ →	0.153	0.072	2.114	0.035
Direct Y X	$\hat{c}'$ →	0.208	0.129	1.607	0.108

CONFIDENCE INTERVALS OF MODEL RESULTS

	Lower .5%	Lower 2.5%	Estimate	Upper 2.5%	Upper .5%
M ON					

X	$\hat{a}$ →	0.030	0.104	0.339	0.574	0.647
Y ON						
M	$\hat{b}$ →	0.086	0.174	0.451	0.728	0.816
X	$\hat{c}'$ →	-0.125	-0.046	0.208	0.461	0.540
Intercepts						
M	i_3 →	-42.378	-37.196	-20.702	-4.208	0.975
Y	i_2 →	-35.681	-30.190	-12.713	4.764	10.255
Residual Variances						
M	$s^2_{\hat{e}_3}$ →	0.442	0.554	0.911	1.268	1.380
Y	$s^2_{\hat{e}_2}$ →	0.442	0.555	0.912	1.270	1.382

CONFIDENCE INTERVALS OF TOTAL, TOTAL INDIRECT, SPECIFIC INDIRECT, AND DIRECT EFFECTS

		Lower .5%	Lower 2.5%	Estimate	Upper 2.5%	Upper .5%
Effects from X to Y						
Total	$\hat{a}\hat{b} + \hat{c}'$ →	0.021	0.102	0.360	0.618	0.699
Total indirect	$\hat{a}\hat{b}$ →	-0.033	0.011	0.153	0.294	0.339
Specific indirect						
Y M X	$\hat{a}\hat{b}$ →	-0.033	0.011	0.153	0.294	0.339
Direct Y X	$\hat{c}'$ →	-0.125	-0.046	0.208	0.461	0.540