Handout on Testing Mediation & Moderation Effects

This example builds on the dataset presented for the single mediator model, adding 50 additional cases to the data. Subject fitness level acts as a moderating variable in the example. Cases 1-50 are normal subjects and cases 51-100 are fit subjects.

```
data a;
input case x m y;
fit=1;
if _N_ <51 then fit=0;

datalines;
 1     70    4    3
 2     71    4    3
...
49     72    4    5
50     70    2    2
...
51     69    2    3
52     70    2    4
...
99     70    3    3
100    71    4    3
;
```

TWO METHODS FOR TESTING MODERATION IN SINGLE MEDIATOR MODELS

Method 1: Compare equivalence of regression coefficients across groups.

Step 1: Run the mediation equations separately for each group.

```
proc reg data=a;
by fit;
        model y=x ;
        model y=x m;
        model m=x;
```

Method 2: Examine significance of interaction terms added to the overall mediation model.

Step 1: Compute means for the sample to center predictor variables in the model.

```
proc means data=a;
```

Step 2: Using means of the X and M variables computed in the proc means statement, center predictor variables and create interaction terms. Note that 70.13 was the mean for the X variable and 3.13 was the mean for the M variable in this example.

```
data all; set a;
centeredx=x-70.13;
centeredm=m-3.13;
```

Step 3: Use the moderator variable to create interaction terms in the data.

```
if fit=0 then z=-1;
if fit=1 then z=1;
```

```
xz=centeredx*z;
mz=centeredm*z;
```

Step 4: Run the mediation regression equations for the overall sample. Now include interaction terms as predictors as well.

```
proc reg data=all;
model y=x z xz;
model y=x m z xz mz;
model m=x z xz;
run;
```

SAS Output for Method 1:

Mediation Regression Equations for Group 1:

```
------------------------------------------ fit=0 ------------------------------------------

                          The REG Procedure
                            Model: MODEL1
                       Dependent Variable: y

                          Parameter Estimates


                              Parameter      Standard
Variable    DF                 Estimate         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


                          The REG Procedure
                            Model: MODEL2
                       Dependent Variable: y

                          Parameter Estimates

                              Parameter      Standard
Variable    DF                 Estimate         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



                          The REG Procedure
                            Model: MODEL3
                       Dependent Variable: m

                               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

Mediation Regression Equations for Group 2:

---------- fit=1 ----------

The REG Procedure
Model: MODEL1
Dependent Variable: y

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-18.03226	12.37693	-1.46	0.1516
x	1	0.30040	0.17660	1.70	0.0954

The REG Procedure
Model: MODEL2
Dependent Variable: y

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-0.60955	14.00132	-0.04	0.9655
x	1	0.03592	0.20349	0.18	0.8606
m	1	0.34750	0.14901	2.33	0.0240

The REG Procedure
Model: MODEL3
Dependent Variable: m

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-50.13710	11.47023	-4.37	<.0001
x	1	0.76109	0.16366	4.65	<.0001

Is the mediated effect the same across groups or is the effect of temperature on water consumption through perceived thirst moderated by fitness of the participant?

Examine whether there are significant differences in the mediated effects across fitness-based groups of participants (analogous to testing the difference in mediated effects in multiple mediator models). All

covariances among the estimates are zero and drop out of the equation because we have independent groups.

$$\frac{\hat{a}\hat{b}_{group1} - \hat{a}\hat{b}_{group2}}{\sqrt{s^2_{a1b1} + s^2_{a2b2}}}$$
$$= \frac{.15272 - .26448}{\sqrt{.005489 + .016096}}$$
$$= -.76069$$

Since this value is less than |1.96| we know that there is not significant moderation of the mediated effect. That is, the mechanism by which temperature affects water consumption is the same across normal and fit participants.

SAS Output for Method 2:

The MEANS Procedure

Variable	N	Mean	Std Dev	Minimum	Maximum
id	100	25.5000000	14.5035697	1.0000000	50.0000000
x	100	70.1300000	1.0215358	67.0000000	73.0000000
m	100	3.1300000	1.1340016	1.0000000	5.0000000
y	100	3.1300000	1.1340016	1.0000000	5.0000000
fit	100	0.5000000	0.5025189	0	1.0000000

No overall significant interaction of XZ on Y

The REG Procedure
Model: MODEL1
Dependent Variable: y

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-20.04137	7.74452	-2.59	0.0112
x	1	0.33038	0.11044	2.99	0.0035
z	1	-0.09348	0.10925	-0.86	0.3943
xz	1	-0.02998	0.11044	-0.27	0.7866

The REG Procedure
Model: MODEL2
Dependent Variable: y

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-6.66122	8.27130	-0.81	0.4227
x	1	0.12179	0.12009	1.01	0.3131
m	1	0.39927	0.10453	3.82	0.0002
z	1	-0.13186	0.10319	-1.28	0.2044
xz	1	-0.08586	0.12009	-0.71	0.4764
mz	1	-0.05177	0.10453	-0.50	0.6216

Fitness level does not affect how perceived thirst affects water consumption of participants

The REG Procedure
Model: MODEL3
Dependent Variable: m

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-35.41976	7.11889	-4.98	<.0001
x	1	0.54984	0.10152	5.42	<.0001
z	1	0.09749	0.10042	0.97	0.3341
xz	1	0.21125	0.10152	2.08	0.0401

Fitness level does affect how temperature affects perceived thirst of participants

Analysis shows that there is heterogeneity in the action theory (i.e., the *a* path) of our mediation model due to fitness level of the participants. The way in which the mediator is related to the outcome however, or the conceptual theory of the model, is not moderated (i.e., homogeneity in the *b* path).