Skill-Builder Series (Part 4): Multiple Linear Regression - Mediators and Moderators

with Dr. Zin Htway

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Walden University

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Dr. Zin Htway: Good morning.

This is Dr. Zin.

We're just having a little technical difficulty.

We'll be starting shortly.


I am so sorry.

We had a little bit of a technical error with our captioning pod, and we wanted to make sure that everyone would have access to the transcript at a later time, so we had a plan B in place here, so it looks like we have that here.

So I'm going to actually -- you know, at the end of the webinar, I'll actually put that in there.

And you know what, let me do that now as a matter of fact, just before we start.

And this is going to be for the transcript for the captioning.

And then I'll also put it in at the end.

So anyway, we're seven minutes over.

I would like to welcome everyone for coming this morning to
21 Linear Regression Series, Part 4.

22 This is the last one for our series in linear regression

23 with Dr. Zin Htway.

24 And just a little bit of housekeeping items.

25 The session is being recorded.
And as a matter of fact, let me just make sure to check that as well. And that is done. Okay.

And if you have any questions for Dr. Htway, please use the chat box. And we have a Q and A period at the end that he can take time to answer those. Any links that we present in the session is interactive, and if there are any questions regarding the session, you can contact myself.

My name is Kim Palermo-Kielb. I am the coordinator of the Tutoring Services Program here at Walden, and you can reach me at ASCtutoring@waldenu.edu.

I will post this presentation on our Skill-Builder website. We have an archived website for our past webinars, and also, if you haven't gotten a chance to go through the rest of our earlier linear regression webinars, please go to that to catch up.

That will also be posted.
And on our Weblinks box, we have a survey if you could take a moment and let us know how you're doing and get your feedback. There is a link to the Skill-Builder recording archive page and our tutoring.
center page where Dr. Htway is actually also a tutor on our dissertation schedule.

So again, welcome.

And, Zin, I'm just going to let you take it away because we're so short on time.

So thank you again for being patient.

>> No problem, Kim.

All right.

Welcome, everybody.

So as Kim stated, we're going to be looking at linear regression, mediators and moderators.

And this particular session, as previous sessions, we're going to be focusing on the application to mediators and moderators for doctoral research, and, as always, if you're not familiar with linear regression, the family of tests, I always recommend that you make yourself more familiar with those because the tests themselves are really
21 quite deep.
22 And in our 30 minutes, we really just kind
23 of touch on the concepts and applications,
24 but there is of course quite a bit more to
25 go with these.
So let me go ahead and move forward here. All right.

So when we look at moderators, because there are actually two concepts, there are mediators and moderators.

A moderator variable, it really reflects -- it changes the strength of the effect of a relationship between two variables.

A moderator may either increase the strength of the relationship, decrease the strength of the relationship, or change the direction of a relationship as the value of the moderator itself changes.

So for simplicity, for this example in linear regression, our predictor will say is it a scale or continuous variable.

Our outcome would be the same, a scale or continuous variable, and our moderator will also be a scale or continuous variable.

We already have a relationship between the
predictor and the outcome, which we could do

a simple linear regression, and we could go

ahead and get a coefficient.

Or if we were to do a multiple linear
regression, we would input both the
predictor and the moderator, and then we would get a mathematical model. The way that the moderator works is as the moderator itself increases in value, it actually will change the coefficient of the model. So if the moderator is low, we have a certain value. And as the moderator increases to middle range, we have a different value. And as it gets at the higher end of the moderator, we then have a third value. When we look at the effect on the top row, the little blue box, it's for non-moderator effect. We see when the moderator in itself has a low value of family continuous scale, our slope, which is shown here at the orange arrow, has a slight rise to it. At the middle value, we still maintain the
21 slight rise.

22 At the high value, we have the same rise,

23 not much change.

24 When the moderator is actually effective at

25 the low value, we have a slope.
At the middle value, the slope increases, and then it changes again at the high value. That's what we would call the moderator effect whereas the one above is a non-moderator effect.

Mediators on the other hand are a little bit different. We once again have our three variables, our predictor, our outcome, and this time we're looking at a variable that could be a mediator.

Now, if we consider all of these once again, as scale or continuous, we can look at from the predictor to the outcome. We would call that a direct effect, which is designated by a purple arrow labeled as C. We also have a relationship between the predictor and the mediator, which is designated by the orange arrow, and then we have a relationship between the mediator and
21 the outcome, which is B.

22 So the mediator in itself when we add it

23 into the model -- let me back up.

24 Without the mediator, there's a relationship

25 between the predictor and the outcome.
But when we add the mediator into the model, we'll actually see the direct effect C be reduced in terms of the coefficient. When we have a perfect mediator, the relationship between the predictor and the outcome -- when we put this perfect mediator into the model, the relationship between the predictor and the outcome actually becomes non-significant. And so that's when we notice a perfect mediator. So mediator variables specify how or why a particular effect or relationship occurs. Mediators describe like the psychological process that occurs to create the relationship, you know, for social science studies and why there's always dynamic properties of different individuals, say, for instance, emotions, beliefs and behaviors for those of you who are working
21 with social science research.

22 So to run the mediators and moderators, I'm

23 using a plug-in for SPSS developed by

24 Dr. Andrew Hayes.

25 It's known as PROCESS.
It's a free download that you can go at to this website here. If you need to use it, you can do an internet search. I search in Google PROCESS by Andrew Hayes. You open up your SPSS. You just follow the directions. You open it up, and you follow steps, and it plugs into SPSS. This is one of the more easy and more popular methods for determining moderators and mediators. And it's really quite a strong program. In my SPSS, I've already had the PROCESS software installed. And to run the moderation analysis, you run to SPSS. Go to analyze, we've got a side bar -- sorry. Drop-down menu, analyze, go to regression,
and in a side bar menu, we'll see PROCESS is an option. It opens up in a similar window that we're used to seeing. For this particular analysis, for my outcome...
variable, I use a variable named DV for dependent variable.

The independent variable, which is our predictor, I'm using IV1, and then for my moderator variable, in this case they call it M variable, it's M, you see IV2.

On the left-hand side, the software has a number of different models that it can run, and the models are numbered from 1 through 72.

For simple moderation, it happens to be number one.

For simple mediation, it's number four.

And there's a number of different models. So there's another 68 -- another 70 different models that can be run.

And if you want to know more about this, I suggest you get the textbook from Andrew Hayes because it gives a complete explanation.
One other feature about PROCESS is that it actually runs bootstrapping. Bootstrapping, the default setting is 1,000 iterations, so it's actually going to be running a thousand computations once you hit
It's important to note that the software does run bootstrapping with the moderation and also with the mediator in that it's important that your computer have the hardware requirements to be able to run bootstrapping because statistical software takes up a lot of computer power. So it will slow your -- it will actually slow your computer down for a few minutes while it actually runs these computations. So we hit the okay button, and then as always, you get quite a lot of output from the SPSS program with the PROCESS software. It does like a little bit different than the normal SPSS output. It shows us the first part here is that the Model 1, that Y represents our dependent variable, and the X represents our IV1, and the N variable represents IV2.
The DV, IV1 and IV2 are just my variable names. Whatever variable names you use will actually appear here. One note is that it will only list the first
eight letters of whatever variable you have,
so you want to make sure that your first
eight letters of your variables are always
unique.
And here it shows the sample size.
And for my particular data set, it was 401.
Now, when we look at the table, one of the
tables that it puts out, we've got our model
summary, which gives us our R squared and
the mean standard error, F values and such.
But what we're really interested in is the
actual model in itself, and this is a --
it's very similar to our traditional linear
regression output we get from SPSS where we
have our constant, and then we get the beta.
And then we've got our variable number two,
which is our predictor -- sorry -- our
variable number two, which is our moderator.
Number one, which is our predictor.
But what we are most interested in is
actually that which is in blue, which is the
interaction.

It's the interaction between our predictor
and our moderator that we're looking at.
And since -- if you go across, you actually
see the coefficient is negative \( .0609 \).

And we look at the P-value.

And PROCESS puts out a P-value.

I know that the SPSS puts out a sig.

Our P-value is actually quite low.

It's \( .0000 \).

The LLCI and the ULCI, those just represent

the lower confidence interval of the

coefficient and the upper limit of the

confidence interval for the coefficient, so

those are essentially our 95% confidence

intervals.

So we can see here that the P-value -- this

is a statistically significant moderator.

In our next table that we look at, we can

actually see our variable 2, which is our

moderator.

Now, PROCESS actually calculates this value

out from the data in itself.

At the low moderation value of negative
21 12.1736, the effect is actually a negative
22 1.16.
23 And once again, we see the P-value.
24 It's significant.
25 We've got our lower limit and our upper
The middle value, PROCESS actually sets it at zero. And we can actually see that the effect is a negative 1.9, which is also significant. And then at the high value, where it's at the opposite end where it's 12.1736, which is in purple, the effect is even increased to negative 2.64. And once again, that is statistically significant. So going back to -- so our little slide here, if we look at the lower row where it's actually moderator effect, using our numbers -- our previous numbers, we can see that for the low moderator, our slope goes down a little bit. For the middle moderation where it's set at zero, it goes down, the slope is more steep, and then at the high end, we have an
21 increase in the steepness of the slope.
22 So you can see here that the moderating
23 effect from low, middle and high actually
24 increases the slope in a negative direction.
25 Now, we can go ahead and run this again
This time in place of our independent variable two, for the moderator we're going to put in IV3. We're just going to swap those out, and then we just run it again. Here's part of our output. We can see that our moderator is IV3. Sample size is still the same. Here's a little bit more for output. And once again, we focus on that last blue line, the interaction. We can see our coefficient is .02. This time if we look, our P-value is actually not significant anymore. And here we are, it's the interaction between the predictor and our moderator. When we go to our next table, when we look at our low, middle, and high, we can actually see the effects.
The effects are listed, the green being the low, the blue being the middle, and then the purple being the high, and we can note that even though we've -- it shows the negative effect, we can see that the P-values are not
And what's important is that if we look at the lower limit of the confidence interval and the upper limit of the confidence interval, if you look at all three of those, the green, the blue, and the purple, each one of those includes the value of zero because it goes from negative .388 to .1837. So meaning that that's a reflection of the effect. Right?

It's the confidence interval of the effect. And if the effect includes the value of zero, then we would say that there is no relationship, or we would stay with the null hypothesis that IV3 is not a moderator or there is no moderating effect.

And so graphically, if we look at the top row, the non-moderating effect, we can actually see that at low, middle, and high
21 moderation values there is not much change in the slope.

22 The confidence intervals of the slope actually would cross -- would actually include each other's values, so there is no
18
1 change unlike what we would see at the
2 bottom row.
3 Now, to run mediation, we would go through
4 the SPSS, analyze regression and PROCESS
5 software again.
6 This time for mediation, we're going to keep
7 our DV as our outcome variable.
8 This time I'm going to use variable number
9 five for the independent variable, and I'm
10 going to use variable number six for my
11 mediation variable.
12 And since I want to run a mediation, just a
13 simple mediation, I'm changing the model
14 number to four, and once again, it's going
15 to be running the bootstrapping.
16 And on the options button, options button on
17 the right-hand side, there's a number of
18 additional tables that you can pull for
19 things such as effect size, interactions,
20 interaction effect sizes and such.
Those are way beyond the scope of this webinar today, so we're going to stay with the simple. But if you need to know more about those, I highly recommend you get Andrew Hayes’
All right. So we get the same -- once you hit okay, we get the same output here.

And once again, when we're looking at mediators, we actually see it's Model 4, then it's the DV, the variable five, variable six.

Sample size is 401.

The output is actually on the bootstrapping. And we want to make sure that the bootstrapping confidence interval does not include the value of zero. And we'll look at that real quickly here.

It puts out -- the SPSS puts out a number of different tables, but what we're looking for is the indirect effect of our predictor on our outcome, which is X on Y.

We have our variable number 6.

We look at the effect as being .1518.
21 This is the bootstrapping results.
22 We’ve got the standard error, the
23 bootstrapping, and then we look at the lower
24 limit and the upper limit of bootstrapping
25 for the effect.
Now, as long as -- and this output, it was .1197 as a lower and then .1817 as the upper. Since the confidence interval of the bootstrapping output does not include the value of zero, then we would say that there's a statistically significant output for variable number 6. Variable number 6 is a mediator. So there is no -- the output does not include a P-value. So we wouldn't write up about a P-value. We're just going to look at the confidence interval. So if it does not include the value of zero, then we would call it statistically significant or a significant result. Now, so what we're looking at here just to get back to this drawing, we're actually looking at the indirect effect of the
mediator on the relationship between the predictor and the outcome. And I just put this back up just for a reminder of what we're actually trying to achieve.
Now, to run another analysis, another variable, we're going to go back to SPSS. And this time we're going to swap out variable number six for variable number three. We keep everything else the same. Click on the okay button. We get our first output which is Model 4, we've got our DV, our variable number five, that's X. And our mediator is variable number three. Sample size is the same. Here we have a non-significant result where the bootstrapping confidence interval includes the value of zero. And the indirect effect output, we can look at our effect, is pretty low. It's .003. There's our standard error, and we look at the lower -- the bootstrapping confidence.
intervals which go from negative .0023 to positive .0042.

So that includes the value of zero, and it's a pretty narrow range.

So in that sense, we would actually write
this up as saying that independent variable number three is non-significant or is not a mediator of the relationship between the predictor and the outcome.

So there's -- we have our relationship between the predictor and the outcome, which is the direct effect is C in the purple arrow.

The indirect effect of this particular mediator is not significant so it really doesn't change the value of C.

And once again, if you were to run these individually through multiple linear regression you would actually see that there isn't really much of a change, so.

Okay.

So getting to the APA write-up.

I've got two slides here on that. The first one is going to be on the write-up for linear regression for a moderator.
So the way that -- now, this is just a template that you could plug in and then change and then add in whatever else you needed to answer your research questions. But we look at it as to investigate the
research question, a simple moderator analysis performed using PROCESS.
The outcome variable for analysis was DV.
The predictor variable for our analysis is IV.
Whatever your predictor variable is.
The moderator for the predictor analysis was your independent variable M.
The interaction between IVP and M was found to be statistically significant.
And we put in the beta, which is the coefficient, and then we would list up the confidence interval and P being less than .05.
The conditional effect of IVP on DV show corresponding results at the low moderation.
IVP equaling whatever the output was from PROCESS.
The conditional effect qualitative DV with our confidence interval being less than .05.
21 Middle moderation IVP equaled zero because
22 that’s the way the PROCESS puts it out
23 unless you want to change that.
24 The conditional effect equals EEE.
25 And here’s our confidence interval.
1 P less than .05.

2 And high moderation IVP equals CCC.

3 And conditional effect equals FFF with a

4 confidence interval.

5 These results identify independent variable

6 as -- I'm sorry -- our independent variable

7 moderator as either a negative, positive, or

8 non-moderator.

9 Other relationship between IVP and DV.,

10 of course, if you have a non-significant

11 result or a non-statistically significant

12 result, you would change these around to fit

13 that.

14 But this kind of gives you a general idea.

15 It's a bit more simple for a mediator.

16 for the APA write-up.

17 But this write-up is just a small subset of

18 the larger write-up that you would use for

19 this particular mediator.

20 But in the basics here we have just, to
investigate the research question, simple mediation analysis was performed using PROCESS.
The outcome variable for the analysis was our dependent variable.
The predictor variable for the analysis was our independent variable predictor.

Mediated variable for the analysis was IVM.

The indirect effect of IVP on DV was found to be statistically significant.

We would list our effect size and our confidence interval.

Now, like I said, this is very basic. It's just a few sentences.

But if you needed to include the actual effect size of the mediating variable, then you would just select that option from PROCESS and it would give you the effect size.

We've got a few minutes for questions.

If you've got questions, please feel free to write them into the chat box.

>> Kim Palermo-Kielb: I did put some information in there, Zin.

In the chat for tutoring with you as well --
21   >> Dr. Zin Htway: Great.

22   >> Kim Palermo-Kielb: -- if students would like to meet

23        with you one-on-one.

24   I'm sure we're going to get some questions about the add-on

25        in the StatsChat Live! account and such.
So I just wanted to let students know about that.

It looks like they're quiet this morning.

>> Dr. Zin Htway: The PROCESS software is relatively easy.

It seems intimidating, but it's not bad once you go through this.

>> Kim Palermo-Kielb: Okay.

>> Dr. Zin Htway: Yeah, we actually use some of the PROCESS software for outside of social science research.

We use it for some genetic analysis because the human geno, there are so many gene sequences you can actually look at different things to see what the final effect is on different diseases.

So it helps you narrow down what you're actually looking for when you want to find something.

>> Kim Palermo-Kielb: Why is it usually for the -- I saw that you had mentioned about psychology.

It's because of like emotion, cognition, that kind of thing?

Is that what they mainly use it for?

>> Dr. Zin Htway: Correct.
21 That's what it originated from.

22 I just took it and used it for genetic science because it

23 worked well for that as well.

24 >> Kim Palermo-Kielb: Oh, wow.

25 Okay.
1 Yeah.

2 I get that.

3 And also, too, I think -- the research 8250 course, we're

4 getting a lot of questions from students, I think, I don't

5 know which course -- maybe that was the textbook you were

6 talking about.

7 >> Dr. Zin Htway: I think it's advanced quantitative where

8 they actually -- I think they actually study mediators and

9 moderators, but --

10 >> Kim Palermo-Kielb: Right.

11 >> Dr. Zin Htway: I don't remember there being use of the

12 PROCESS plug-in.

13 I think it's just you have to understand the theory and the

14 concepts but not an actual assignment.

15 >> Kim Palermo-Kielb: I see.

16 I see.

17 Yeah, because we were getting -- go ahead.

18 I'm sorry.

19 >> Dr. Zin Htway: I was saying I do remember we had a

20 number of students ask about how to use the PROCESS
That's exactly what I was wondering.

So I wasn't sure if it was part of the course or not.

Because I was getting some questions about the Andy Black software, because they would come across it. 
28
1 text as well.
2 So I was curious.

3 But -- well, it looks like we're just down to one.

4 Our other participant dropped off.

5 So let me just go to the ending slide here and let,

6 again -- so we have Corine still.

7 If you have any questions about the webinar, Corine, or if

8 you would like to meet with Dr. Htway you can email myself

9 at ACS tutoring@waldenu.edu.

10 I'm going to stop the recording, and I also put that link

11 in there for the transcript -- for the running transcript

12 since we had a little bit of the issues with the captioning

13 pod.

14 But thank you, Corine, for sticking with us, and thank you,

15 Zin, for presenting today.

16 I appreciate it.

17 And this is our last one, I believe, right, until next

18 year?

19 Or I don't know what's -- or maybe fall.

20 I'm not sure.
>> Dr. Zin Htway: Yeah, until next time we figure out --

>> Kim Palermo-Kielb: Yeah, our next session.

I guess we're going to have to brainstorm a bit soon.

And I'm also going to go over the surveys and find out what

students are asking for, and I can let you and Patrick know
what we come up with to come up with some topics.

Have a good rest of your day.

And I appreciate you doing this.

And I'm sure our students do.

And I know you have a tutoring session.

I was looking on the schedule today.

>> Dr. Zin Htway: Yeah, I'm up at 9:00 here.


Exactly.

All right.

Well, I'll end this session, and everybody take care, and

I'll talk to you soon, Zin.

Thanks again.

>> Dr. Zin Htway: Thank you, talk to you soon.

Bye-bye.


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