Marketing Research and Analysis-II (Application Oriented)
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Lecture – 58
Mediation and Moderation Analysis in SPSS

Welcome everyone. The final session of SEM. So in the last lecture we are discussing about what is SEM and it is also called as a path analysis the covariance analysis. So we talked about that it is also called a structural model. You are trying to establish a relationship among several or develop several hypothesis and this hypothesis is based on certain theory right which you must have read in literature.

And if suppose there is no literature also do not worry that means you can talk to experts and then you know come to some logical conclusion that this should happen A should effect B then such a kind of situation where there is relationship existing on basis of some logic then you create a model and you test it. So this is a second part so which say the first part is a measurement model where we try to connect the constructs and see that the model is a fit.

And it is a valid model and the second part we are checking that this in the structural model that the relationship among the various constructs is there is some kind of relationship a positive or negative or some kind of a relationships right. So today after doing that what we have learned today we will continue with the same and we will talk about a new concept here which is more important called mediation and moderation right.

So what is mediation and what is moderation we will learn about it and what is the role of mediation and moderation in SEM and any statistical analysis we will see. So what is this mediation? Mediation effect is created when the third variable constructs intervenes between two other related constructs. You see many a times in life it so happens if I tell you a joke or you know you can understand better.
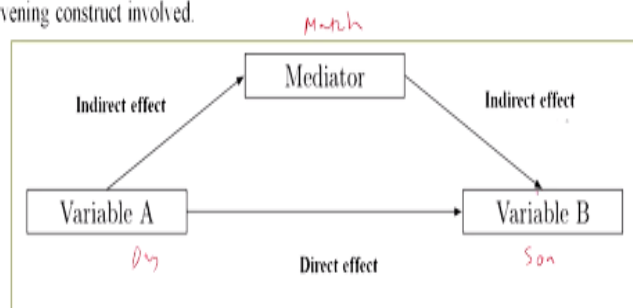
For example, in India we have seen when there is a marriage between a boy and a girl so if there is an arrange marriage then we see that you know if there is you know kind of a person who is doing this getting proposals for boys and girls if he is present then the pace at which you get proposals for you know for your son and daughter becomes little more right. So there

if you do not have this mediator this we say suppose a Brahmin right.

In earlier days we say used to say it is a Brahmin. So if this Brahmin is there his job was to do match making and if he is present then you will get more number you know such proposals, but if the Brahmin is not there then even you try to search for yourself for your daughter and son it becomes it used to be very difficult so this is just an example.

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So mediation effect is created when the third variable intervenes between two other related constructs. Direct effects are those for example that links the two constructs with a single arrow. Now you see there is a variable A and there is a variable B and there is a direct effect. So A directly effects B, but indirect effects are those relationships that involve a sequence of relationships with at least one intervening constructs or the mediator.

So now A effects B but now through the mediator. So earlier the parents you know the father of a daughter let us say and the father of and this is let us say son father of a son. So searching for each other was a very difficult proposition, but today when the presence of this match maker is there so it becomes little simpler. So this relationship is weak then the same when you pass through the mediator and reach here so this becomes more faster.

In chemistry or chemical terms, you can understand the presence of a catalyst right or sometimes some enzymes expedite the reaction or you know the growth so this is the mediator okay.

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Mediation (contd...)

❑ From a theoretical perspective, the most common application of mediation is to explain why a relationship between two constructs exists.

❑ *For example*, suppose A= student intelligence, B=class performance, and M= study effectiveness.

❑ What is interesting is not just that the relationship exist between intelligence and class performance, but how students translate their intelligence into performance.

❑ Study effective (M) may provide an explanation of relationship between student intelligence (A) and class performance (B).

So from a theoretical perspective the most common application is to explain why a relationship between two constructs exists why does it exist example. Suppose A is student intelligence B is class performance and M= study effectiveness okay. What is interesting is not just that the relationship exist between intelligence and performance right, but how students translate their intelligence into performance okay.

So study effectiveness this M mediator may provide an explanation of the relationship between student intelligence and class performance. So if this mediator would not have been there then you would not have may be able to understand why this happens. So the mediator role is to explain why that why, why it is happening why it is the reaction becoming much at a much faster pace so this is what it explains.

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Conditions for mediation

Let, A= independent variable, B= dependent variable and M= mediator.
❑ A should be related to B.
❑ A should be related to M.
❑ M should be related to B.

Estimate an initial model with only the direct effect between (A) and (B). Then estimate a second model adding the mediating variable (M), between (A) and (B).

❑ If the relationship between A and B remain significant and unchanged once M is included in the model of A and B, then **mediation is not supported**.
❑ If the relationship between A and B is reduced but remains significant when M is included as mediator, then **partial mediation** is supported.
❑ If the relationship between A and B reduced to a point where it is not statistically significant after M is included as mediating construct, then **full mediation** is supported.

So what are the conditions for mediation first of all let us understand. Let A= independent variable and B is a dependent variable and M is a mediator. So there are 3 variables the mediator the dependent and independent variable. So what it says is this is from the you know we will talk it about from the Baron and Kenny model right Baron and Kenny. So you can search for it also there is a very popular paper what it says A should be related to B.

A the independent variable B the dependent variable so A effects B. A also is effected or related to M what is M the mediator. M should be related to the B which is the dependent variable. So A is independent variable B is my dependent variable M is my mediator. Estimate an initial model with only the direct effect that means we are saying only the direct effect A effects B there is no mediator then estimate a second model.

Now the second model is A effects B, but now it is effecting through M let us say this is the one right. So we might not use this one we might just try to see this effect right between A and B. If the relationship between A and B remains significant the relationship between A and B remains significant and unchanged once M is included in the model, then mediation is not supported.

That means what suppose let us say you forget this when you introduce the model the M the mediator. Now after introducing if M is very important then this relationship should have become direct relationship should have become weak, but if does not happen this is still significant and this is insignificant then we will say that the mediator is not doing any work okay or it is not supporting.

If the relationship between A and B is reduced this relationship is getting weakened okay A and B, but remain significant it is still significant although it is weak but significant. When M is included then we will say there is a partial mediation. What is this a partial mediation is supported. Suppose this value this estimate right is becoming little poor and it is less significant when once you introduce this M then we say it is a partial mediation case.

The third relationship it says if the relationship between A and B is reduced to a point which is not significant now. So we cannot say there is a relationship is existing and A effect B we cannot say that right. It is not statistically significant after M is included as a mediating construct then it is a case of a full mediation. So that means what if M is present and while if

you go to B through M then it takes let us say less time or it is more effective.

Then and this becomes this path becomes completely insignificant then we say it is a very clear case of a full mediation okay.

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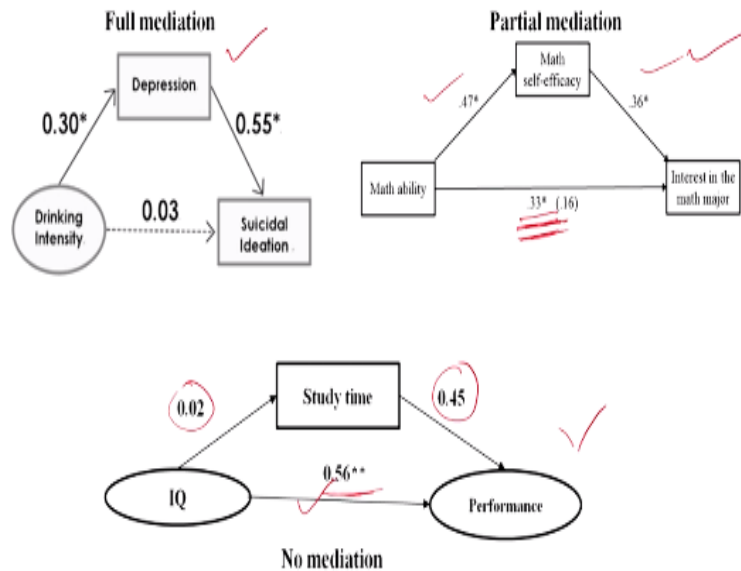
Now look at this 3 diagrams. So drinking intensity it leads to suicidal ideation. So people who have a high drinking intensity it leads to suicidal intention it is a hypothesis, but if let us say if we pass through a mediator depression that means what if the presence of depression is there or not how that effects let us see. So if somebody is drinking a lot drinking means drinking alcohol.

If he drinks a lot, then there is a chance of his getting depressive right and if he is getting depressive then the chance of suicidal intention is becoming more right. So this when this depression construct was introduced a variable was introduced then this relationship has suddenly become very weak or insignificant then it is a case of a full mediation right. Now let us look at this case.

Now IQ effects performance and we introduced the amount of study time also. So we would say the study time is the mediator let us see if it is a mediator or not. Now if you look at the estimate the loading IQ and study time it is 0.02 and study time and performance is 0.45 and IQ to performance is significant and it is at 0.50 which is I think the highest out of the three, but you see the point is since this is the direct effect is the highest.

So there is no you know there is no effect of the mediator as such and both are not significant. So that is why since there is no effect of the mediator it is a case of a no mediation case there is no mediation. Now here you see when Math self efficacy Math efficacy was introduced this is the relationship between Math ability and interest in the Math major. So if somebody's Math ability is good or high or low will it effects the students interest in taking this subject as Math as a major subject.

So to have that we have introduced a Math self efficacy that means can he do it on his own. So when we introduce this construct or variable what has happened you see this relationship is strong and also significant. Now this relationship is also strong and significant, but this also is strong and significant. It has weakened maybe it has decreased, but it is not completely it is not insignificant it is still significant.

So when this is also significant and these 2 are little stronger than this value right this direct effect value then it is a case of partial mediation right. So this is partial mediation, this is no mediation this two are not significant only this is significant and you see this one now this has become insignificant and these two are significant. So this is a case of full mediation okay. How to do this mediation analysis in AMOS.

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Mediation

Example

This study is the carry forward of the ABC paper industry example which was covered in CFA and SEM analysis. The example is as follows:

ABC paper industries deals in finished products made by papers. They employ around thousand workers in India. Like many other companies they are facing the problem of attracting and keeping productive employee. The cost of replacing and retaining employees are high. ABC management wants to understand the factors contribute to employee retention. The company wants to test a measurement model made of factors that affect employees attitudes and behaviours about remaining with ABC. 5 constructs were observed in SEM. The company wants to check whether JS and OC mediate the relationship between AC and SI, and EP and SI

(Name of the constructs: Job Satisfaction (JS), Organizational Commitment (OC), Staying Intentions (SI), Environmental Perceptions (EP), Attitude toward Co-workers (AC))

So we will take the same case of the paper industry ABC paper industry which was covered right. So this we have seen there are 5 constructs job satisfaction, organizational commitment, staying intention, environmental perception, attitude towards co-workers right. So we are 5 constructs and we want to see how they are related.

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Proposed model of ABC
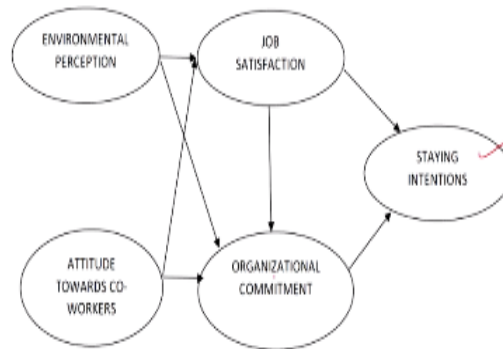
Now you see now final thing is that you want to find is staying intention correct and these are my 2 independent exogenous constructs right. Now you see organizational commitment is a mediator is acting as a behaving as a mediator between environmental perception and staying intention okay. Similarly, job satisfaction is also acting as a mediator between environmental perception and staying intentions.

Another thing is job satisfaction between job satisfaction and staying intentions organizational commitment is also creating as a mediation. Attitude towards co-workers and staying intention their organization commitment is the mediator. So some of these variables are playing the role of mediator also okay. So remember I have told you this arrows have not come on their own you have to have some sound theoretical perspective for developing this directional relationship okay.

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Mediation check
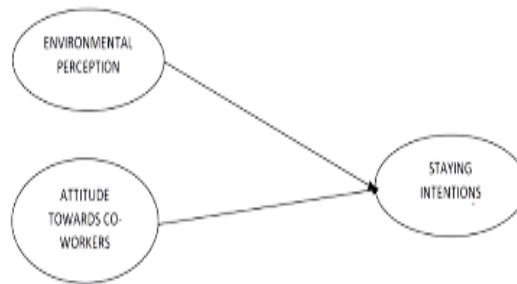
To check the mediation first check the direct effect of EP and AC on staying intentions

Now we have to do that first of all let us see what is this environmental perception attitude and staying intention, environment perception attitude and staying intention let us forget these two right and we create a direct relationship. So we say environmental perception directly effects staying intention, attitude towards co-workers directly effects staying intentions.

To check the mediation first check the direct effect of these two EP and AC on the staying intentions let us see right.

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Mediation check
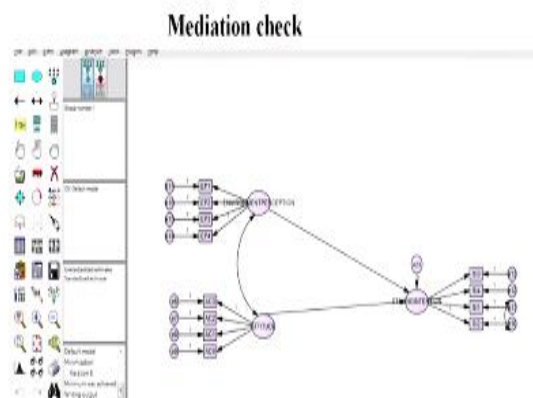
Run the Amos analysis as given on the figure above and take down the standardised regression weights and P values for the above relationship

So when we do this so when we run this I will show you I have this I brought this data set so we are talking about this one. Now you know how to take the data and all so how to put in the data. So you can go to files, data files right file name so this is a file so open okay. Now you

have inserted the variables you have done it now let us run this. So let us see the direct effect. So when we take the direct effect let us see.

So first of all check whether the model is fit or not okay. So well the model seems to be quite robust no issues with it. Now let us see the direct effects. Now direct effects if you see environmental perception, effect staying intention yes it is significant at a 0.001 level. Attitudes effect on staying intentions is significant so we require these two correct okay. Now let us see let us go back to the slide right.

So let us check the mediation effect. So first we will take the direct effect model okay so this is a direct effect model. So environmental perception and attitude both this exogenous variables are effecting the staying intentions. So just look at it what you should do you first create this direct effect I have already done it. So this is the model right so now I am running it. So when I run so I will get some results okay.

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First you look at this analysis summary what it says it is a without mediator direct effect. Now let us go to the, you know, you can check the model fit also it is highly it is a very good model.

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So now let us go to the estimates. So when you go to the estimates what did you have environmental perception. So the model was so this was environment perception and staying intention correct. So environmental perception on staying intentions so this is the one. So environmental perception on staying intention so environmental perception on staying intention.

So look at this you know first environmental perception staying intention is it significant yes it is significant. So the next one was similarly attitude towards co-workers and I think staying intentions. So attitude and staying intention is this significant yes okay. So both the direct effects are significant and the estimates thus standardized regression estimates are 0.528, 0.178. So we now know that the direct effect is significant and these are the estimates.

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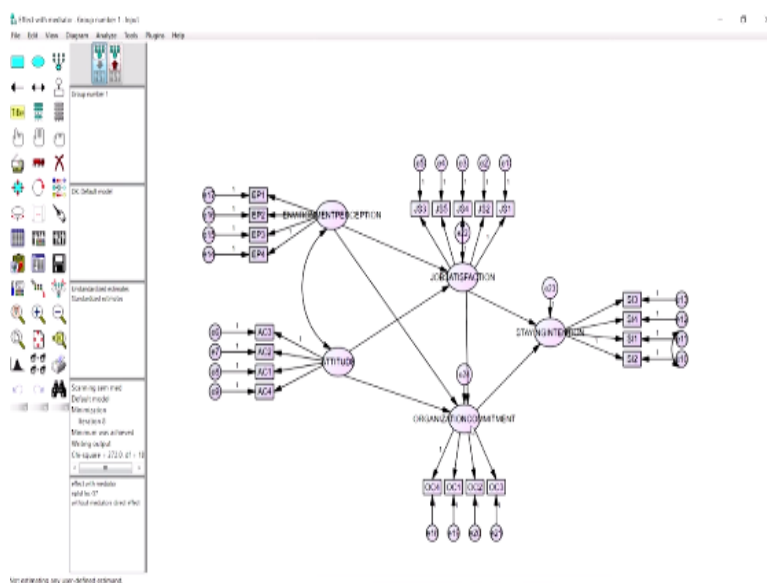
Now we will see for another model where you have the complete model where the mediators are present. So environmental and staying intention in between that you are getting a job satisfaction, environmental and let us say staying intention you have got a organizational commitment. Similarly, attitude and staying intention you got a job satisfaction and similarly organizational commitment.

Now when we run this now the mediators are present so when we run this we will get a mediator effect let us see what is the mediator effect.

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Now if you go to the analysis summary so what it says effect with the mediators okay.

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Now let us see the model fit. So now the direct effect was model was better or this model.

Now if you see this chi square by degree of freedom this value has improved. So now improved here means that higher the value lower the model fit okay. So the model has not improved as such the direct model was better than this mediating model right because this value has improved.

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Now still let us see the estimates. Now if you look at the estimates. So environmental perception leads to job satisfaction attitudes leads to job satisfaction, attitude goes through organizational commitment right, job satisfaction leads to organizational commitment and then environment perception leads to organizational commitment, organizational commitment then goes to staying intention.

So if we go through this indirect path each path let us see first of all environmental perception to job satisfaction is this significant yes and then from job satisfaction to staying intention so let us see job satisfaction to staying intention. Is it significant? Well not that high right. So it is significant if you take at a 0.05 level, but at a 0.01 level no right. So one of the you know the direct effect was highly significant.

But here one is significant the other is not significant. So in this case we cannot say that this is a mediation effect and overall the model has also improved. Now second case attitude and job satisfaction right. So attitude effect job satisfaction okay is it significant not at all. So that means again the relationship between attitude and staying intention through the mediator job satisfaction is also not a valid case so there is no mediation effect.

Now let us take the third case attitude and organizational commitment significant yes. Now organization commitment and staying intention this is significant yes. Now you see this is also significant and this is also significant and the direct effect was also significant. So we can check the regression effects here you can check this values. So let us see let us go back again.

So attitude towards organizational commitment right so attitude towards organizational commitment 0.201 and organizational commitment towards staying intentions 0.552. So if you see now it is the direct effect was also significant the indirect effect is also through the mediator also significant. So that means what it is a case of partial mediation right. Now do you have any other thing to show a full mediation.

Full mediation would have been possible only if the direct effect would become you know weak. So what you can do is simply you can do one more thing go to this model. Take this and create develop an arrow which is a direct path right and again develop one more arrow from here to here okay. So in the same model let us see now what is going to happen okay. So let us see this estimate okay.

Environmental perception and staying intention so let us go to environmental perception, staying intention. Is it significant? Yes, it is significant so the direct effect is significant. Now environmental perception now through the mediator now job satisfaction is it significant yes then job satisfaction to staying intention this one is it no, so no mediation case. Now second case attitude towards you know staying intention the direct effect.

Let us see the direct effects attitude to staying intention it is not significant it shows here the direct effect is not significant. Now if we go through the mediator what happens let us see. Attitude towards job satisfaction right is it significant no so this case has also gone. Attitude towards organizational commitment yes and organizational commitment to staying intention let us see organizational commitment to staying intention significant.

Now in this case when organizational commitment is becoming the mediator you see the model is becoming significant, but if you would have taken directly removing organizational commitment then the model was insignificant. So this is a case of full mediation organizational commitment is showing a full mediation is fully mediating the relationship

between the attitude and staying intention.

But if you would have taken the other variable which was job satisfaction then it was a case of no, no mediation right because it was not improving the model so when you see this 3 cases have happened when one when the direct effect is significant but the indirect effects are the mediating effects there is no effect or there is no improvement then it is a no significant mediating effect case right.

If the direct effect is insignificant but the indirect effect or the mediating effect is fully significant then it is a case of full mediation, but if this would have been significant the direct effect and the mediating effect would also be significant then it is a case of partial mediation this is the 3 case right. So I hope you have understood what is mediation effect.

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Mediation check

Make a table as given and note down the standardised regression weights and P values for the direct effect of EP and AC on staying intentions

Relationship	direct effect without mediator	effect with mediator	Observation
EP to JS			
EP to OC			
AC to JS			
AC to OC			

Now let us go back to the slide. So we have check this so you can draw a table like this and write the relationship the direct effect and the effect through the mediator what happens right. So this you can develop on your own and you can show it right.

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Mediation check
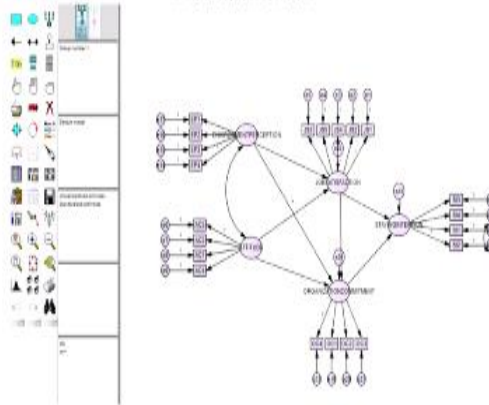
Now build the overall model again now to check the mediation between EP and
Si through JS, we need to delete the path between EP and OC so that Ep can be
only mediated by JS

I have this table also. Now build the overall model again to check the mediation between EP
and Si through JS EP and Si through JS EP and Si through OC so you can check this right
okay.

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Mediation results

Results:

AC to OC: As we can
see that the P value is
significant for both the
relationship but with
effect with mediator
the loadings are better
so OC fully mediate
mediates the
relationship between
AC and staying
intentions

Relationship	direct effect without mediator	effect with mediator	Observation
EP to JS	.528 (***)	.278(***)	Partial mediation
EP to OC	.528 (***)	.457(***)	Partial mediation
AC to JS	.178(***)	-0.010(.86)	No mediation
AC to OC	.178(***)	.201(***)	Full mediation

This is how the results is shown and here if you see suppose this value is a tentative value.
Suppose 0.528 was a direct effect and 0.278 is through the mediator there is a case of partial
mediation. Now 0.528 is a direct effect and 0.457 is through the mediator again a partial
mediation because both are significant. Now look at this case it is a direct effect is significant
but this one is not.

So what should have happened here it is a no right no mediation. This one is significant this
one is significant, but this one is higher right so this is the case of a full mediation but this is

still not a very bright case had this become insignificant and this would have become significant then it is a clear case of a full mediation okay, but this is still because this model has improved.

But here the model was significant but this was a larger value so it was a case of partial mediation right okay. Now coming to the next part is moderation what is moderation.

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Moderation

❏ **Moderating effect** occurs when a third variable or construct changes the relationship between two related variables / constructs.

❏ **For example**, we would say that a relationship is moderated by size of company if we found that the relationship between two variables differed significantly between large and small. *(example.*

❏ In multiple regression, for example there were interaction terms. Similarly in ANOVA, interaction effect were used to assess whether the differences between groups.

❏ In both the example, the interaction effect is in fact a **moderator**.

Moderation effect occurs when the third variable or construct changes the relationship between two variables. Examples let us say in some cases for example does the gender of a person effect the ability the emotional stability or how emotional somebody is for others does the gender have an effect. So if you want to see the effect of gender or it is the effect of religion or the kind of place they come from.

Suppose you want to see such things then this is called a moderating effect okay. Example there is very slight difference between moderation and mediation I will try to clear you what is the difference. For example, we would say that a relationship is moderated by size of company. If we found that the relationship between two variables differ significantly between large and small companies for example firm size okay.

In multiple regression for example there were interaction terms or in ANOVA when you are doing you have heard about interaction right so in ANOVA right. So this interaction is nothing but the differences between groups. So this is what we do in the moderation effect. So for example the gender effect the female and male behave different is a group behavior.

So that is what is a moderation effect or you can understand there is an interaction effect.

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Moderation

❑ Moderating variable must be chosen with strong theoretical support.
❑ Lack of a relationship between the moderator and the other constructs helps distinguish **moderators** from **mediators**.
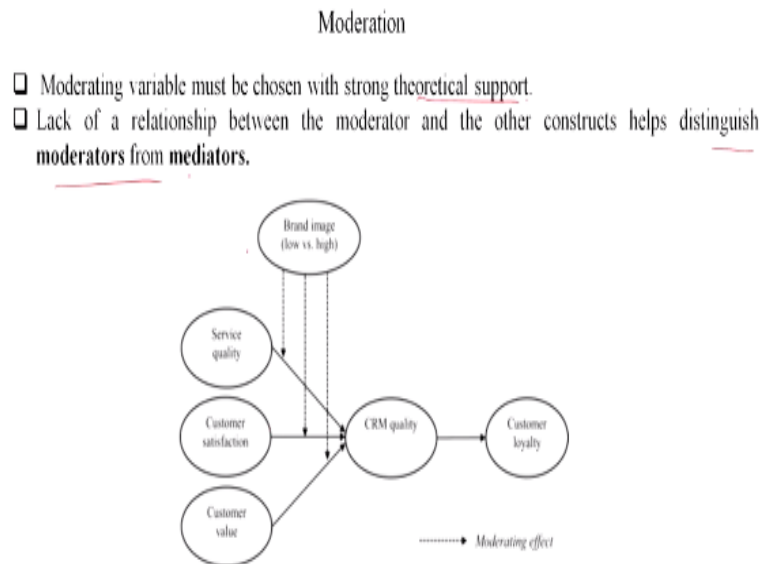
Now for example you see moderator must be chosen with strong theoretical support. Lack of relationship now this is very, very important please lack of a relationship between the moderator and the other constructs helps distinguish moderators from mediators. Mediators do have a relationship right but moderators are not directly related because for example in our case emotional stability we talked about gender.

Now gender moderates but gender is not directly related so the constructs are not related to each other right. It would have been related constructs then it is a case of mediation right, but here we are talking about a new variable or constructs which is not having a relationship. As we said gender, size of companies and all these things okay. So you see CRM service quality, customer satisfaction value affects CRM quality effects the customer loyalty.

Now this is a mediation mediator effect right this is mediator. And this is a endogenous variable and this are my exogenous variables. So and in this one has got no relationship may be because high image, low image has no relationship with service quality satisfaction and value. So I would term it as or let us say the color of the mall let us say for example it has got no relationship then that is my moderating effect color of the mall you know the kind of music being played in the mall or some example I am just saying.

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Types of moderation

Non metric moderators
❏ Non metric, categorical variables often are hypothesized as moderators.
❏ For example, gender, age etc.

Metric moderators
❏ A moderator can also be a continuous /metric variable and evaluated using SEM.
❏ If continuous variables can be categorized in a way that makes sense (i.e., based on theory or logic), then groups can be created and the same procedures used for non metric moderators can be applied.
❏ For example, job satisfaction can be used as a moderator by converting into categories such as highly satisfied and less satisfied.

Types of moderation. So non metric so generally we use non metric moderators but suppose you have some categorical variables or sorry continuous variables sorry or metric variables that can also be done. What you can do is you can categorize in a way that make sense right. For example, job satisfaction can be used as a moderator by converting into categories such as highly satisfied and less satisfied.

Suppose you know the income of people let us say there are hundreds of people you have their (26:00) income. So instead of taking the exact value let us say 9000 so what are 9,200 let us say 10,800 let us say 11,600 let us say 21,000. So what I am doing is I want to do is I will say anything less than 10,000 I will place it in group number 1 anything between let us say 10,000 to 20,000 I will place in 2 and anything above let us say 20,000.

I will place in the group number 3 so now I have created 3 groups. So continuous variable I have converted into categorical variables and I can use it in the moderation okay.

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Using multi-group SEM to test moderation

❏ Multi group SEM is used to test moderating effects. Metric moderator is converted into non-metric.

❏ The first group model is estimated with path estimates calculated separately for each group.

❏ A second group model is then estimated where the path estimate of interest is constrained to be equal between the groups.

❏ Comparison of the differences between models with a chi square difference indicate if the model fit significantly changed when estimate are constrained to be equal.

❏ If the model are not significantly different, then there is no support for moderation.

So multi group SEM is used to test moderating effect. Metric moderator is converted into non metric okay. The first group model is estimated with path estimates calculated separately for each group. I will show you a second group model is then estimated with a path estimate of interest is constrained to be equal between the groups. Now what we do is basically we look at the chi square difference right between the model.

And if there is a significance now see comparison of the differences between the model with a chi square difference indicates that model fit significantly change when estimate are constrained to be equal. If the model are not significantly different there is no support for moderation I will tell you what it is. Now let us see.

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Let me show you a moderating effect let us say here. I want to introduce and see the effect of

size of the company so what I do is how to run the moderation you go to this. So first I am creating a new variable sorry close I have created too many. So here I will write right so this is large L okay then new I am saying. So this is now I will say this is small okay. So we have created this two groups now.

So just you have you know I have written L and I have this is and here I have written S so small right. So now I have to give the let us say go to the view and I have to see the variable in the data set so I have to not taken the I have to take the file so data file so okay file name okay this is the file open okay right. So again sorry I should not have closed it. Now go to the grouping variable.

Now what is my grouping variable size okay. What is my group value now 1 is for large so 1 okay right? So large is 1 and small is go to the file name it is not required you can just go to the grouping variable. So again size okay and the group value 2 is my small okay. So I have got my 1 and 2 values large and small and I know about it. So now when I am running this model you see what will come. So we get the analysis so first check the model fit right this is for the entire model okay.

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Now what you can do is you can go to the estimates right and you can go for this two you can see this two L and S. So this two what we had given 1 and 2 numbers right large was 1 and this was 2. So if you see now the model the relationships. For large companies for example environmental protection how the relationship between environmental protection and job satisfaction, attitudes and job satisfaction, attitude and organizational commitment all of this.

You can see here that the first one is significant the second one is not significant third one is significant fourth is not significant, 5, 6 significant 7 is not at all significant, 8 is significant and 9 is not significant right if you take a 0.01 level. Now same thing let us see for the small firms what it is happening. So if I take the small firms right so you see so the first one was significant there also, but the significant values is changing right.

Second one you see and you one of them was very highly insignificant there what was it 0.998 job satisfaction to staying intention. Let us see here what is happening job satisfaction to staying intention is only 0.22 for small firms. So now you can see that the variables the significance level and the critical ratio this value of the variables is changing for small and the large firms.

So accordingly you can explain now what is the condition when it comes to large firms which of the variables was the relationship are significant and which one of them are not significant and similarly for the small firm you can explain which one of them are significant and which are not. So this comparison between groups is nothing but called the moderating effect right. So I think you are very clear with it.

It is a very simple technique you can easily write it and show it and say when we did a moderation effect we found that the most important thing is try to find out if there is any particular variable which is any particular relationship that is not becoming significant in both the cases then that is a very clear case that it is insignificant for both the relationship so the group does not have a effect on this particular relationship.

But if suppose one is you know effecting the large firms and some other is effecting the small firms, but not the large firms then in that case you can say well the moderating effect shows that this particular relationship is only effective is you know in large firms and not in case of small firms and vice-versa the other relationship was possible and found to be significant in case of small firms but not in large firms right.

So this is what you basically do in case of a moderation effect. Well I think you are slightly clear or you are clear with mediation and moderation effect and if you have understood you can easily write it and publish it in your research work (32:18). Thank you so much.