Applied Econometrics

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Lecture – 79
Autocorrelation (Contd.)

Hello and welcome back to the lecture on Applied Econometrics. So, we are talking about autocorrelation. In the previous lecture we have seen something interesting where we actually plotted data and we fitted a model and we actually estimated the error term u hat and we plotted u hat with time to see, if there is any pattern existing. And we found indeed that there is a that it appears that there is a pattern.

So, it is going slowly down, slowly up and sometimes it looks like the error is expanding with time. So, in this kind of cases we can basically think that perhaps there is autocorrelation. From the diagram, from the plot, we can make a sense that there might be autocorrelation. But to get a sort of you know get the autocorrelation values in quantitative term, we need to do some tests. And we have learned couple of tests, one was Durbin Watson and another was Breusch Godfrey.

So, let us actually in this lecture we will talk about Durbin Watson Test. If we have this kind of data and how we actually perform Durbin Watson Test and what that means? And we again will do that test using both R and stata. So, let us again sort of try to recollect the you know the decision rule that we use in case of Durbin Watson Test. So, we know that Durbin Watson Test the value actually lies between 0 to 4.

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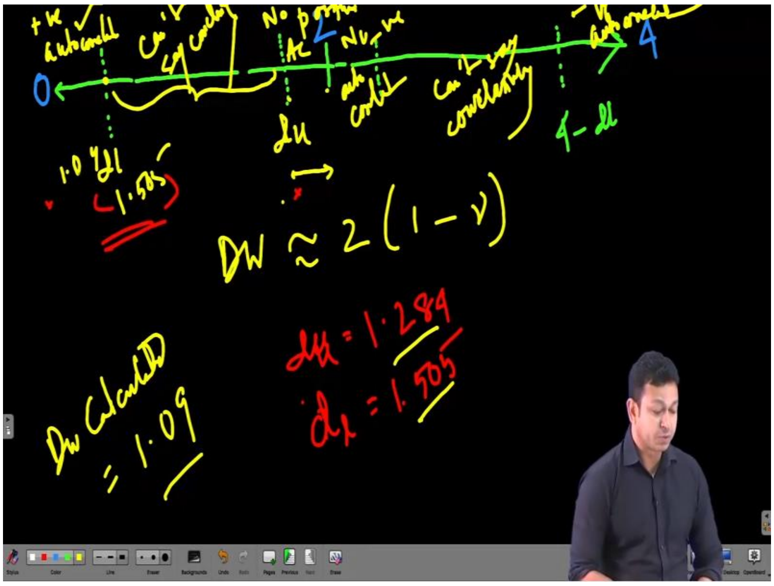

Now, if we have let us say, if we have a number line here, I will use a different colour, if we have a number line starts from 0. So, we remember that the when the Durbin Watson Statistic value is close to 0, we can say that there is a positive autocorrelation. So, that is why we said that if the values, if the Durbin Watson Statistic value is less than d l, some lower critical value for Durbin Watson Statistic.

So, we can say our decision would be positive autocorrelation. So, we say the positive autocorrelation is present. If the value of the Durbin Watson Statistic is actually lower than d l. So, it is close, it is basically between 0 to d l. So, we can say that the value is going to be so that we can say that there is positive autocorrelation. Then the, if we have and we also said, if we have the Durbin Watson Statistic value close, let us say 2, at the value is equal to 2.

We have seen that there is no autocorrelation. When the value is 2, when the value of rho was 0, we got Durbin Watson Statistic value is equal to 2. So, when that is the case, there is no autocorrelation and we can and there was a Durbin Watson upper d u which is the upper critical value for the Durbin Watson Statistic. And if my calculated Durbin Watson Statistic value lies in between these two. So then I will write that there is no positive autocorrelation.

So that is my decision rule, no positive, let me write down no positive autocorrelation. So, if my D W stat computed falls in between this, there is no positive autocorrelation. And in between this, we have said that this is a grey zone and no conclusive evidence or we cannot say anything conclusively. Similarly, now, we can also sort of in the same number line we can also explain the presence of negative autocorrelation.

So, we know, if the Durbin Watson stat value is actually close to 4 then there is a strong negative autocorrelation. And we said that we again use the d u and d l here. So, if we can have some critical value which is 4 – d l. Now, d l is very low, d l let us say 0.5. So, if it is above 3.5 to 4, we say that there is negative autocorrelation. We say that negative autocorrelation and if it is close to 2 so then we say that there is no negative autocorrelation in this zone.

And in between we cannot say anything conclusively let us say conclusively. So that is idea. So, essentially in one line we can actually summarize how we can take the decision regarding autocorrelation from the Durbin Watson Statistic and we remember we got this formula D W = 2 into 1 – rho or 1 – gamma whichever you want to write. Now, we got the decision rule and now, we will actually, first we will use stata to actually see from our previous model.

If we can say something about the Durbin Watson Statistic. **(Video Starts: 06:22)** So, let us go back to our stata. Now, we need to actually you know tell stata that this data set we have is the time series data. For that we need to write a command t s s e t, tset and the time value is year. So, the moment I say it, is it year, it will understand that it is a time series data. If I do not write so, Durbin Watson statistic will not run. So, I have already written it.

So, now, it will run otherwise there would have been problem. Now, if the command is pretty simple and it is the simple the command is D W stat that is it. All you have to write is D W stats. So, the moment I first I actually have to run the regression before I actually write D W stat. I have to run the regression and the regression so, like so, now, since I already have the regression here, I have already run the regression.

So, my Durbin Watson Test so, it will be performed on these residuals. The residuals I have got from this regression equation the dimension test will be performed on this residuals. So, I really do not have to run the regression because I have already run it and it is stored in a stata memory. So, this regression I run in the previous lecture. So, if I write down D W stat. So, it will, it actually has obtained the residual terms from the previous model.

And based on that residual terms it has calculated that this statistic is equal to 1.09. And the degrees of freedom it has 3 and 54. So, 3 is the number of parameters we have to estimate and 54 is the number of observation. So, we need to remember these 2 parameters. Note here stata does not say anything about d u or d l and that is a little challenge that we have but we are going to actually resolve that.

So, now, we see that Durbin Watson Statistic is 1.09 and if I go back to this so, 1.09. So, it is not 2. So, let me use a different colour, it is not 2, it is not close to 0, it is somewhere you know somewhere here. So, I really do not know. It might be, there might be positive autocorrelation or there will be no autocorrelation. So, there are 2 possibilities. So, now, I have to see which one is correct.

Now, from stata you cannot really say anything conclusively. So, what you can do is, there is a Durbin Watson Table available. So, we will actually search for Durbin Watson table. So, we have handy tables available in internet. So, you can just you know open any of these all I need is a table. So, for this tutorial, yeah this is the table. Let me actually increase the font otherwise you will not be able to see it.

So, here you see. So, I have this 2 degrees of freedom k and n. Now, I remember my k was 3 whereas my n was 54. So, if I scroll down, I see that my values are 50, 55, 60. So, I can say maybe it is close to 55. So, you can approximately take the value for 55. So, we will see, if that is sufficient. So, for 55, every degree of freedoms so, for every value of k they have provided d u and d l. So, let me actually show you.

So, this is d l and this is d u. Now, if I go down. So, I will have, I let this first 2 and so, I let this first 2 observation, 4 observation go and I will have the d u = 1.284 and d l = 1.505. So, let me write it down my d u here in this example, my du again let me check 1.284 and my d l is going to be 1.505. So, I got these values and my calculated value was 1.09. So, my calculated value, my D W calculated was 1.09.

Now, what do I see from these 3 numbers? Our life is easy, we have all these 3 numbers and all you have to make is a decision. Now, I see that D W calculated 1.09 is lower than d l. My d l here is 1.505 whereas my calculated value of D W is 1.09. So, it is actually falling in the zone of positive autocorrelation. So, my decision is going to be that my model is having positive autocorrelation from the Durbin Watson Test.

Of course you have to remember Durbin Watson Test is actually operating with certain limitations but we will talk about it when we address the Breusch Godfrey Test. Now, we have seen this in stata. Now, let me actually do the whole exercise in R. For R also, it is pretty simple. Just remember that L M test is the package you have to have to actually run the Durbin Watson Statistic.

So, here also it is actually you know we all you have to do is D W Test, I think the command D W test, very simple D W test and all you have to do is to write down the name of the model here. So, which is mod. So, the from which regression equation it will take? The value it is of the regression equation which is named as mod. So, if I write it here and I will find these values here. Now, look at it.

So, the value of D W is 1.0948 exactly the value we got it in the stata. But here instead of you know getting into all these upper critical, lower critical and everything, we have a very simple p value. So, we know how to what p value means? The p value is really really small here, you see 6.29 into 10 to the power – 5. So that means really really low p value. So that means my alternative hypothesis is given true autocorrelation is greater than 0 which is actually correct.

So, you basically reject the null. So, essentially you say that your model has positive autocorrelation. So, from both stata as well as in R you have seen how to run the Durbin Watson Test and how to say, if the model has autocorrelation or not. **(Video Ends: 13:10)** So, with this we sort of you know do we conclude this lecture. We have done this hands-on Durbin Watson Test and in the next lecture we are going to actually do a little bit of Breusch Godfrey Test. So, with this we end this lecture. Thank you.