Applied Econometrics
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Lecture – 97
Assumptions for Regression Models with Stochastic Regressor

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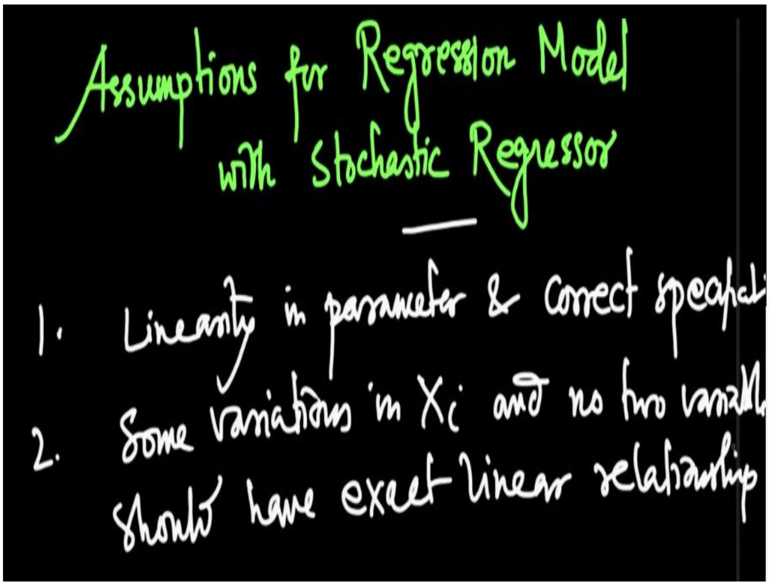

Hello and welcome back to the lecture on applied econometrics. In the previous lecture, we spoke about the assumptions for regression model with non-stochastic regressor and in this module we are going to talk about the assumptions for regression model with stochastic regressor. And previously we spoke about the difference between a stochastic regressor and non-stochastic regressor.

And depending on basically how these two regressors are different, we sort of kind of hinted on some of the assumptions we need to incorporate when you talk about a stochastic regressor. So, in this lecture we are going to outline all the assumptions that you need to make when you are dealing with a stochastic regressor. Now, basically we will see most of the assumptions that we are going to make in case of stochastic regressor is going to be same as that we have seen for non-stochastic regressor.

What are you going to do here, we are going to add couple of more assumptions to make it suitable when my regressor is stochastic. So, let us write down the first assumption and the assumption is exactly what you have seen previously is linearity in parameter and correct specification, so that we have already seen. So, I have already explained it, so I am not explaining further.

The second assumption is that there has to be some variation in X i. You have to have some variation in X i, otherwise if your X i's are constant you are going to have an undefined value of the beta. So some variations in X i and no two variable should have exact linear relationship. Exactly we have talked about; the same assumption should have exact linear relationship, essentially this is talking about the problem of multicollinearity.

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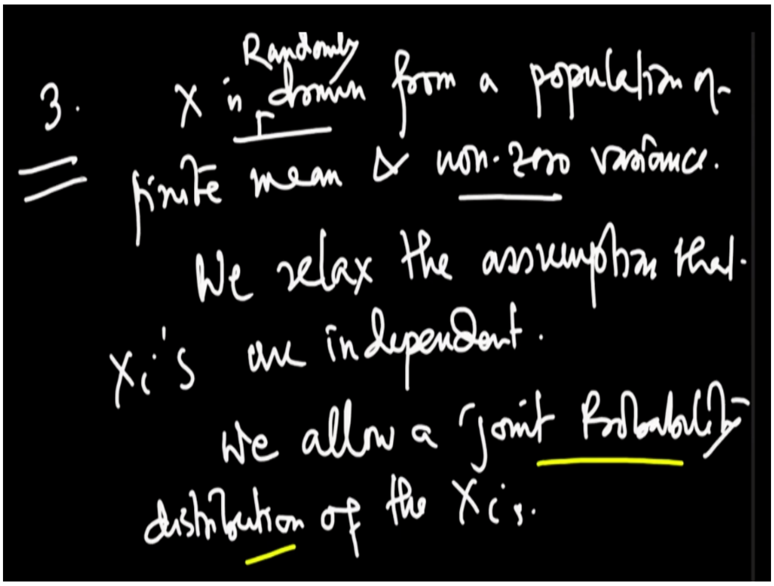

Now, the third assumption is something different for my stochastic regressor and that third assumption we actually have dealt with in detail and that will come from previously what we have discussed is that you are essentially drawing your regressors X i, X i is basically drawn randomly, X i is randomly drawn from a population of finite mean and nonzero variance that we have talked about it.

And we also actually draw it randomly from a population of finite minute nonzero variance, we also said that since the regressor is stochastic we relax the assumption that X i’s are independent. In fact, we said that we allow a joint probability distribution of X i So, this is the third assumption, this is a new assumption basically based on the whatever you have defined my stochastic regressor to be essentially that is the assumptions that you are going to incorporate here.

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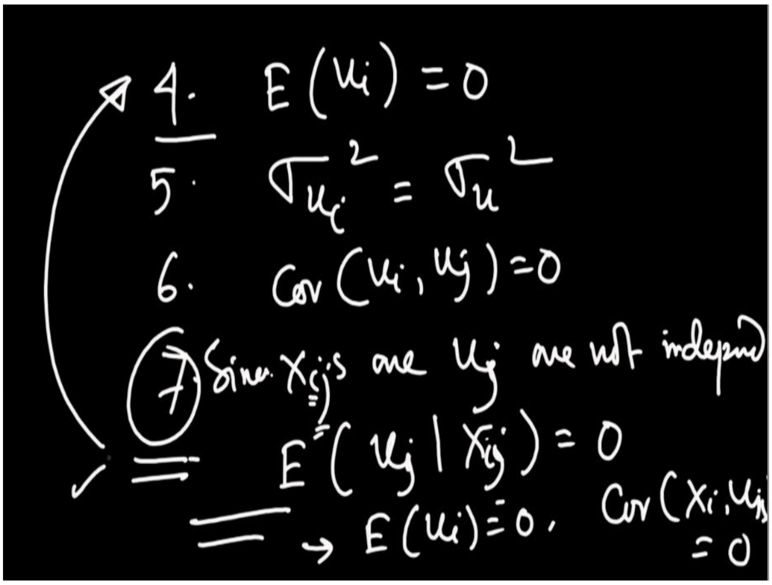

The next assumption is actually exactly from what you have seen previously that expectation of all the error term is going to be 0. The fifth assumption is the assumption of homoscedasticity. So, basically that means sigma u i square has to be sigma u square, so it is homoscedastic. And sixth assumption is again that covariance of u i and u j has to be equal to 0. There should not be any autocorrelation present in the data structure.

Now, the seventh point is important and actually again this is something that we have discussed and that because of the fact that you are allowing this joint probability distribution here there is a chance that X i's and u i are not independent. So basically, I can write if I have many X i's, so let us say x ij or u j let us say if I have i variable and j observations, so X ij and u j's are not independent.

Now, if they are not independent, you can write since X ij and u j's are not independent, you have to ensure their independence. Otherwise, there would be a problem with a blue estimator. So how do you ensure they are independent and we previously talked about it. You can ensure they are independent with assumptions that expected value of u i given all X i = 0 or here I have taken u j, so u j given all X ij = 0.

So, that condition has to be satisfied and only then I can have expectation of u i = 0 or covariance of X i, u i to be equal to 0. And this actually, if I make this assumption that actually takes care of the assumption that I already made in my assumption 4, so I do not need to make this assumption twice, but we can write it just to maintain consistency with the assumptions that we are made for non-stochastic regressor.

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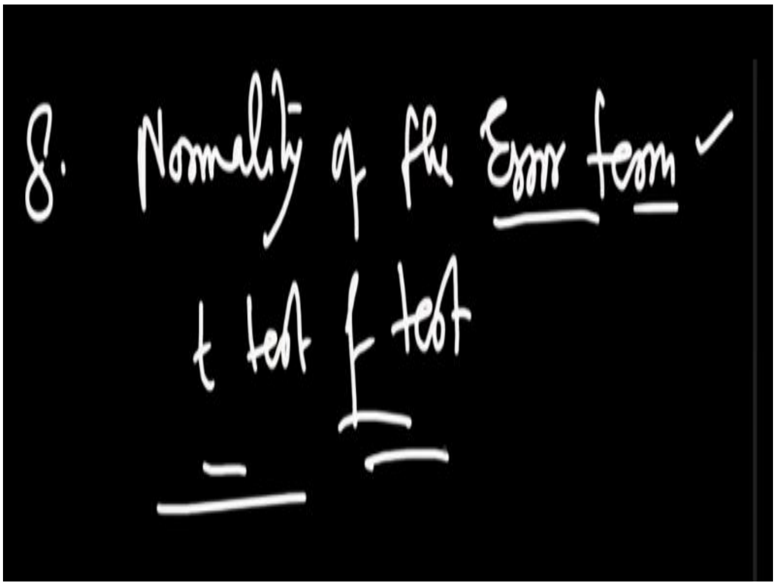

So, coming to the last assumption and that we have seen previously also that the same assumption that is the normality of the error term. And your error term needs to be normal because when we have an error term normal, so then I know that my beta estimated since the component of it is actually dependent on the error term, so it is also going to have a normal distribution.

And the moment I have a normal distribution from a beta term, what I am going to have is I will be actually able to perform t test F test and then I will be able to do the significance test that I want to do. So, essentially, that is why we need to ensure the error term is normal and we also explained previously this is not a big problem because in most of the cases you are actually able to do your t test and F test.

So, these are essentially the assumptions for my regression model when my regressor is stochastic. So essentially, we have seen that we basically included this as a new assumption and this, and both these we explained when we talked about what is a stochastic regressor and just remember that the moment I make this assumption, my stochastic regressor actually behaves more like a non-stochastic regressor.

So, then I do not need to be too concerned about the difference between stochastic regressor and non-stochastic regressor as long as these assumptions are satisfied. So, basically with this we will actually end this lecture on regression assumptions on stochastic regressor. And with this actually we kind of end the whole part of the regression diagnostics. Thank you.