**Econometric Modelling**

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**Lecture No. # 14**

**Trivariate Econometric Modelling (Contd.)**

Good afternoon. This is Dr. Pradhan here. Welcome to NPTEL project on Econometric Modelling. Today, we will continue with the Trivariate Econometric Modelling, in the last class we had discussed briefly about this Trivariate Econometric Modelling where there are three variables in the system; one is dependent variable as usual in the case of bivariate modeling, and two independent variables.

So, now here our objective is to fit a econometric model, where Y is the dependent variable, and two other independent variables called as a X 1 and X 2. Let me first briefly highlight, then we will proceed for its discussion.

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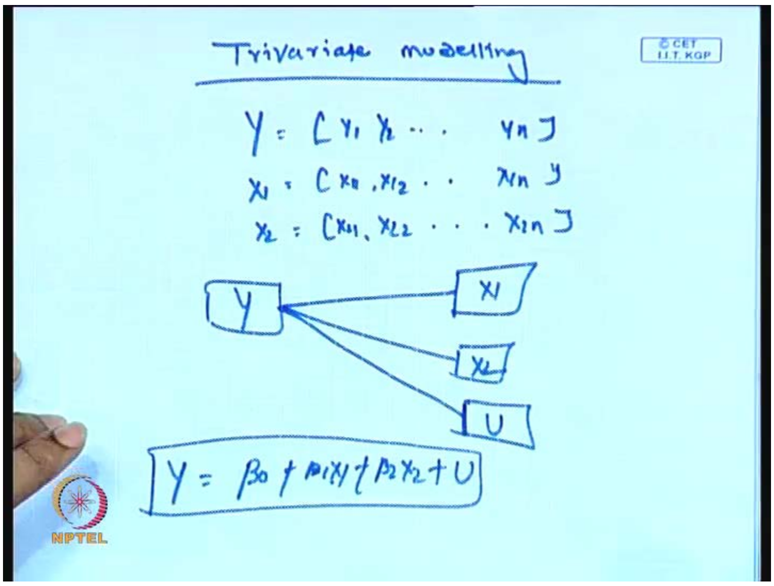


So, let us assume that Y is consist of sample observation Y 1 Y 2 up to Y n, then X 1 consist of X 11 X 12 up to X 1n, and X 2 involves X 21 X 22 up to X 2n with this basic background our objective is to trace X 11 X 1 and X 21 Y.

So, we like to trace the impact on this is X 1 and this is X 2 ; obviously, we have suppose means variable variables u variable that is which we could not able to capture that we will represent in the form of u. So, now we like to know how this is set up and structure in the case of Trivariate Econometric Modelling.

So, briefly if we will put it in a mathematical form then the econometric model is all about like this Y equal to beta 0 plus beta 1 X 1 plus beta 2 X 2 plus u error term. So, this is how you can say econometric model or econometric model is all about. So, here we will put subscript subscript i. So, X 1i this is X 2i. So, let me put it ~~h~~ in ~~a~~ other way.

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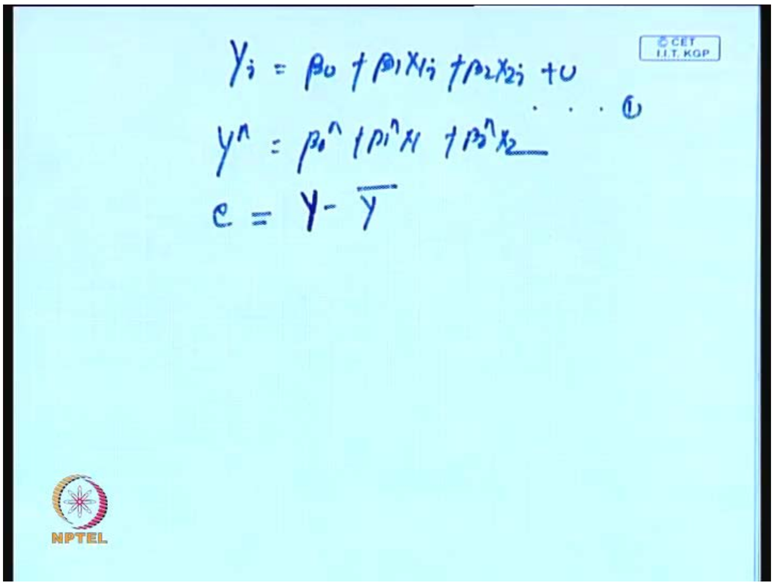


So, here the model will be Y i equal to beta 0 beta 1 X 1i plus beta two X 2i plus u. So, this is put it equation number one then, uh our objective is to fit the estimated model so; obviously, let us assume that the estimated model is beta 0 hat plus beta 1 hat X 1 plus beta 2 hat X 2. So, then next step is we have to design the error component error component is nothing but Y minus Y hat. So, the moment we will get Y error component which is the difference between an original set up and the estimated set setup. So, this is this is nothing but Y y minus not Y bar it is Y hat Y bar is a mean, but here we have to subtract original with estimated value.

So, now here our objective is here our objective is to have the estimated value of beta 0 hat beta 1 hat and beta 2 hat. So, now how do we do that? So, we have to go for error minimization the way we will minimize the errors then automatically we will get the a value of beta 0 hat beta 1 hat and beta 2 hat.

So, as usual you know to minimize this error sum square. So, we have number of techniques like o l s g l s w s m l e. So, here uh you know the way we have discussed in the case of bivariate econometric modelling. So, in the case of Trivariate Econometric Modelling we will also apply the ordinary square method that is wireless technique to get the or to estimate the the way we will apply the wireless technique then we can able to minimize the error sum square and by the process we will have the estimated values of beta 0 hat beta, 1 hat and beta 2 hats.

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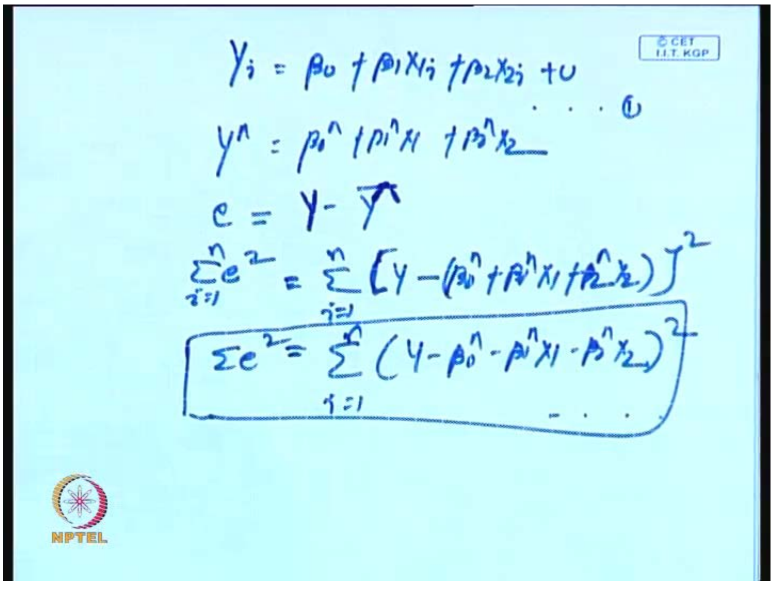


So, we will design the way how we have to receive all these items. So, first track is to have the error sum squares. So, e square i equal to 1 to n is equal to summation Y minus Y hat Y hat. So, which is nothing but beta 0 hat plus beta one hat X 1 plus beta 2 hat. So, i think beta 2 hat X 2. So, this is this is otherwise like this. So, this is squares i equal to 1. So, what we will do?, we will simplify. So, which is nothing but summation Y minus beta 0 hat minus beta 1 hat X 1 minus beta 2 hat X 2 then whole square i equal to 1 to n. So, this is what we call it summation e square. So, summation e square is this much. So, now this is the this is the starting process through which we have to minimize the error sum squares.

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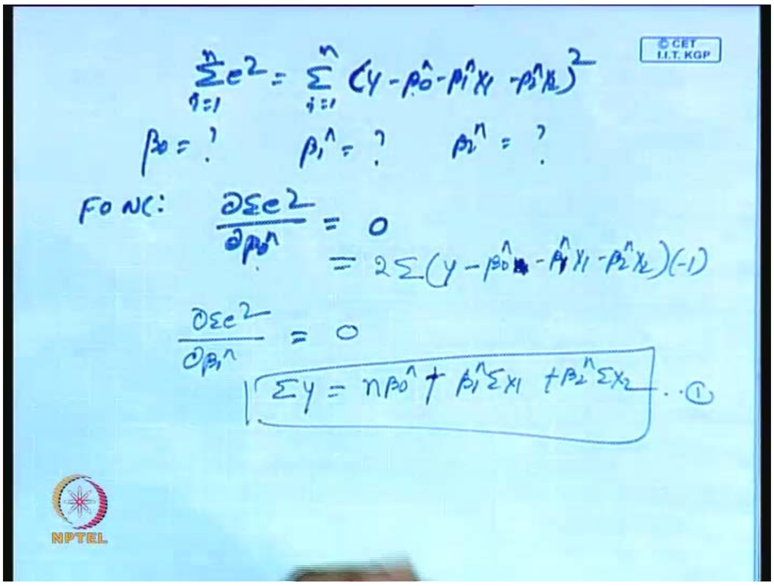


So, now we will move how we have to minimize the error sum squares. So, by the way there are three parameters ~~so~~ that means, summation e square equal to summation Y minus beta 0 hat minus beta 1 hat X 1 minus beta 2 hat X 2 whole squares i equal to 1 to n this is also i equal to 1 to n. alright

So, now our objective is to get beta 0 hat beta 1 hat then beta 2 hat. So, this these are the three specific objectives there are three specific objectives to have the to have the estimated value of beta 0 hat estimated value of beta 1 hat and the estimated value of beta 2 hats. So, now accordingly we have to apply the wireless technique and the way we will minimize then obviously, we have to touch the necessary condition and the sufficient condition.

The necessary condition is nothing but the error sum means we have to differentiate the error sum square with respect to beta 0 hat beta 1 hat and beta 2 hat then then we have to go for the solution of this three equations and by the way we will get beta 0 hat beta 1 hat and beta 2 hat. Let me explain how is it all about. So, first first condition is first order necessary condition is that d summation e square by d beta 0 hat is equal to 0 d beta 0 hat is equal to 0 then if we will go for simplifications. So, then obviously, it is nothing but 2 into summation Y minus beta 0 hat X 1 minus sorry sorry beta 0 hat beta 0 hat X beta 0 hat and beta 1 hat X 1 minus beta 2 hat X 2. So, this is beta 0 hat. So, this is beta 0 hat means minus 1 has to be multiplied.

If we will simplify then d summation d summation e square by d beta 0 hat is equal to means it should be equal to 0 then, if further simplify then it is nothing but summation Y is equal to n beta 0 hat minus no it will obviously, plus because summation Y is coming this side. So, beta zero beta one hat summation X 1 close beta two hat summation X two. So, this is this is equation number one this is equation number one.

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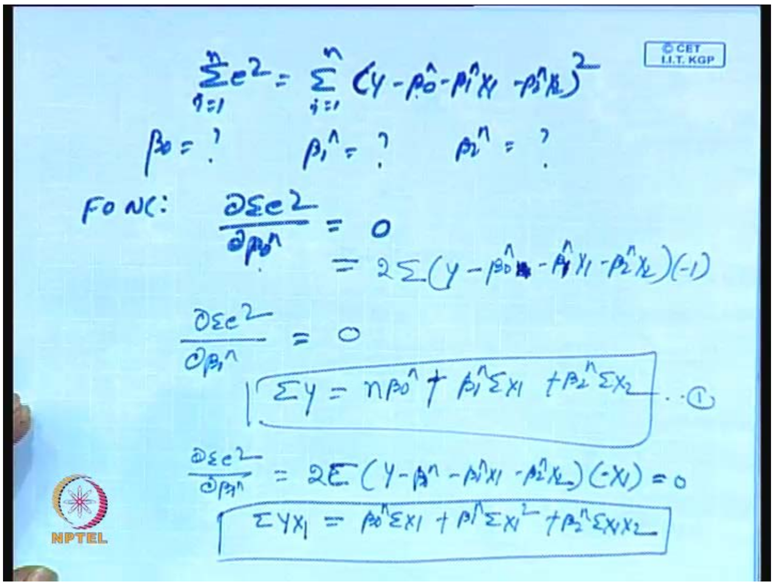

So, now now next step is we have to solve d summation e square by d beta 1 hat. So, d summation e square by d beta beta 1 hat means it is two summation two summation into Y minus beta 0 hat minus beta 1 hat X 1 minus beta 2 hat X 2 into into this is beta one hat. So, it is minus X 1 minus X 1 is equal to zero is equal to zero.

So, now if we ~~will~~ simplify this particular equations, then we will have summation Y X summation Y X it is summation Y X1 summation Y X1 is equal to beta 0 hat summation X 1 plus beta 1 hat summation X 1 square plus beta 2 hat summation X 1 and X 2. So, this is how the second you know second solution for this particular minimization. So, this is equation number two this is equation number two.

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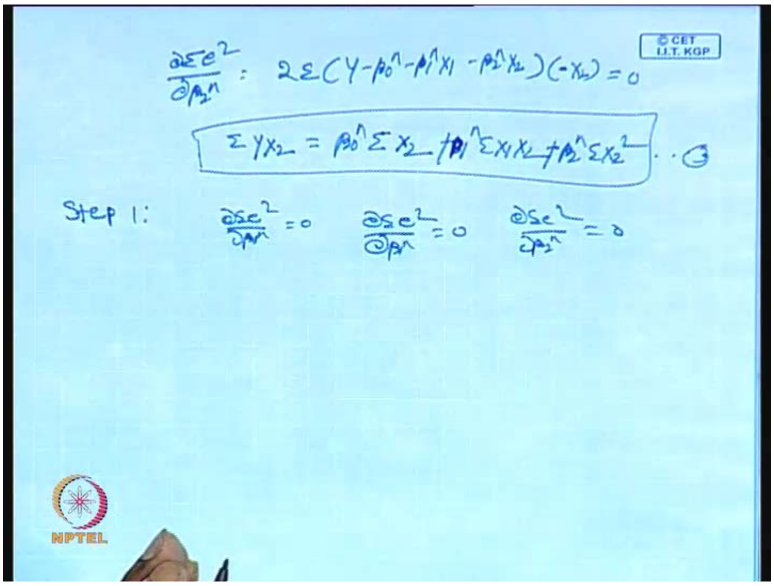

So, now now we have to differentiate with respect to beta 2 hat so; that means, d summation d summation e square by d beta 2 hat is equal to 2 summation Y minus beta 0 hat minus beta 1 hat X 1 minus beta 2 hat X 2 into minus minus X 2 minus X 2 which is equal to zero this is third equation.

So, now we will simplify this third equation then we will have summation Y X2 summation Y X2 is equal to beta 0 hat summation summation beta 0 hat summation X 2 summation X 2 plus beta 1 hat summation X 1 X 2 beta 1 hat summation X 1 X 2 plus beta 2 hat summation X 2 squares. So, this is this is third equation this is third equation.

So, now what we will do. So, the process is in this in this minimization by wireless technique. So, step one process is d summation e square by d beta 0 hat is equal to 0 d summation e square by d beta 1 hat is equal to 0 and d summation e square by d beta 2 hat is equal to 0. So, now if we will simplify then we have three different equations corresponding to beta 0 hat, beta 1 hat then beta 2 hat. So, now if we club together, then this particular this particular problem will be in the form of 10 to 3format. So, that is the simultaneous equation of order three where there are three parameters and there are three equations.

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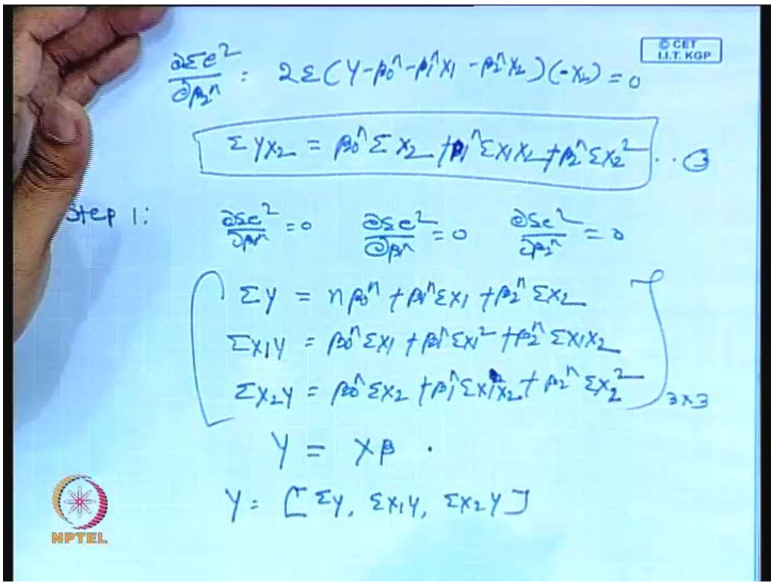

So, the system is very consistent and we can able to get a solution. So, what is this particular structure the structure is here, if I club all these three equations, then it will be coming like this summation Y equal to n beta zero hat and plus beta 1 hat summation X 1 plus beta 2 hat summation X 2. So, then summation X 1 Y is equal to beta 0 hat summation X 1 plus beta 1 hat summation X 1 square plus beta 2 hat summation X 1 X 2. So, then third equation is summation X 2 Y is equal to beta zero hat and summation X 2 plus beta one hat summation X 1 square pus beta two hat summation sorry this is X 1 X 2 this is X 1 X 2 and this is summation X 2 square. So, this is this is nothing but you know three into three equation.

So, we can also we can also put in like this particular structure we can write like this Y equal to X beta plus X beta simply you can say X beta only Y into X beta. So, what is Y here? So, Y represents Y represents here summation Y summation X 1Y summation X 2Y.

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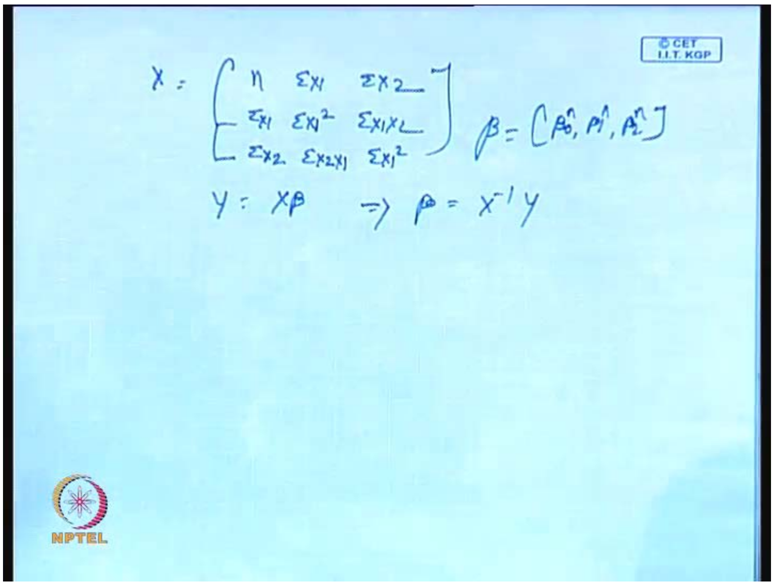


So, this is Y and corresponding to this Y corresponding this to YX represents X represents n summation X 1 summation X 2 then summation X 1 summation X 1 squares summation X 1 X 2 then summation X 2 summation X 2 X 1 summation X 1 square. So, this is X beta consists of beta beta 0 hat beta 0 hat, beta 1 hat and beta 2 hat.

So, this is nothing but Y equal to X beta. So, if we will multiply X inverse both the sides. So, then then we will get the solutions, beta equal to X inverse Y X inverse Y, so; that means,. So, we will simplify this particular three into three model in a matrix format and it is easy to handle this particular problem the entire structure is almost all same now like bivariate econometric model. So, in the bivariate econometric model we had 2 into 2 systems. So, where our objective is to get only you know alpha beta or if we will you know reduce it to this Trivariate to bivariate then the two parameters are beta 0 hat and beta 1 hat.

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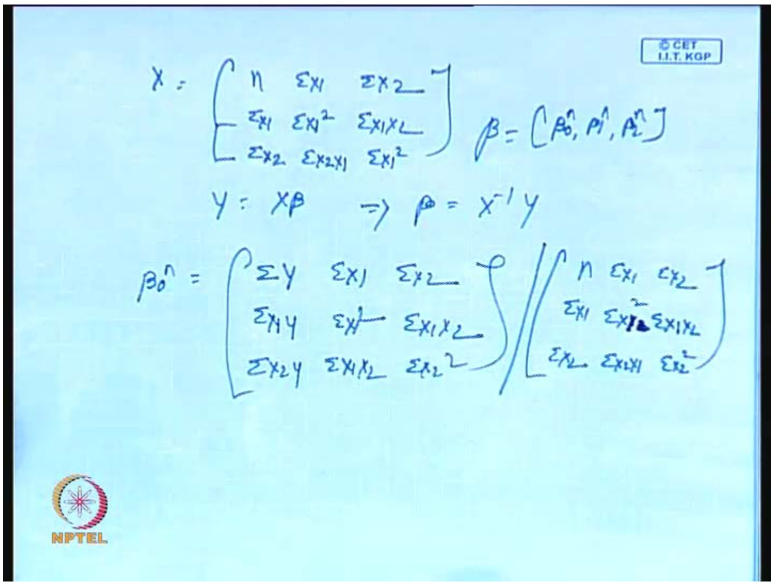


So now in order to simplify all these procedures, how we will get all these equations. So, now if I will simplify then I will get beta 0 hat is equal to the matrix summation Y summation X 1 summation X 2 then summation X 1Y then summation X 1Y summation X 1 square then summation X 1 X 2 then summation X 2Y then summation X 1 X 2 then summation X 2 square. So, this this is beta 0 hat beta 0 hat equal to this divided by matrix a. So, a a is nothing but a n summation X 1 summation X 2 summation X 1 summation X 2 summation X 1 X 2 sorry this is X x 1 squares summation X 1 square this is summation X 1 X 2 this is summation X 2 X 1 this is summation X 2 square. So, this is how beta 0 or beta 0 hat value.

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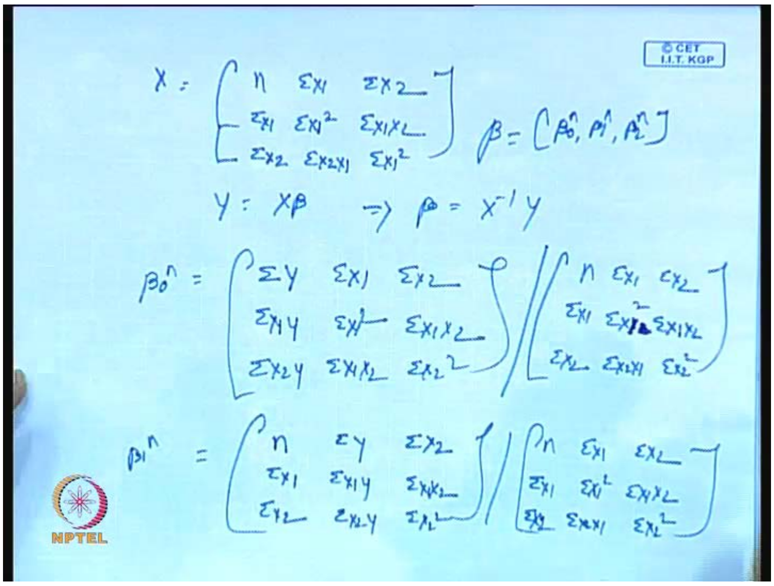

So, now beta 1 hat beta 1 hat is equal to n summation X 1 summation X 2 then summation Y summation X 1Y summation X 2Y then summation X 2 summation X 1 X 2 then summation X 2 square. So, this divided by n summation X 1 summation X 2 summation X 1 summation X 1 square summation X 1 X 2 then summation X 2 summation X 2 X 1 then summation X 2 squares. So, this is what all about beta 1 hat.

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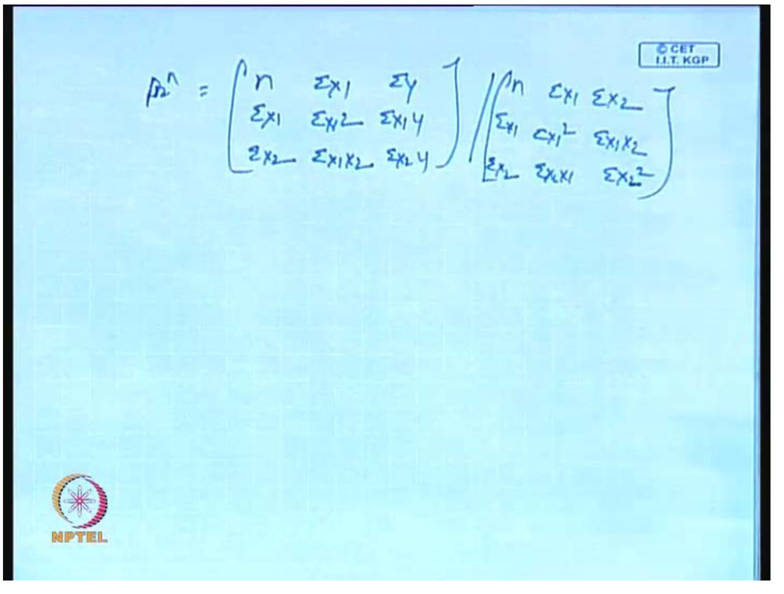

Similarly, we will get beta 2 hat. So, beta 2 hat is equal to beta 2 hat equal to n summation X 1 summation X 2 then summation X 1 summation X 1 square summation X 1 X 2 then summation Y summation X 1 Y and summation X 2 Y this divide by n summation X 1 summation X 2 summation X 1 summation X 2 summation X 1 square summation X 1 X 2 then summation X 2 X 1 then summation X x 2 square. So, this is the beta 2 value this is the beta 2 value.

In order to simplify the entire procedure, we have to apply the you know trick how to get the quick solutions. So, far as you know this is how we have to derive the process to get the beta 0 hat beta 1 hat and beta 2 hat, you know suppose a class room problem is concerned it is required to know how it is coming exactly the value of beta 0 hat beta 1 hat and beta 2 hat, but when we will handle this particular problem through any statistical software then you just you know you know job is very simple just you have to give a command what is the dependent variable and who are the independent variables So, here we are writing you know Y X 1 and X 2 for our simplicity only. So, whether the you know it is very eye catching and it is very easy to understand easy to justify or easy to represent, but you know when we have a practical problems any any finance problem or any business problem so obviously, your problems setup is all about with respect to three variables for this particular Trivariate Econometric Modelling.

So, now what you have to do in this in this particular format if there are three variables and three different names are there for instance last class we have discussed the when there is bivariate models. So, we restricted our model to say stock price versus foreign exchange so that means, we are very much interested to know how forex influence the stock price keeping stock wise is a dependent variable and forex is a independent variable.

So, now we will add another extra variable in this particular nexus between this stock price and foreign exchange. So, let us assume that there is another variable called as ~~a~~ inflation which can influence the stock price.

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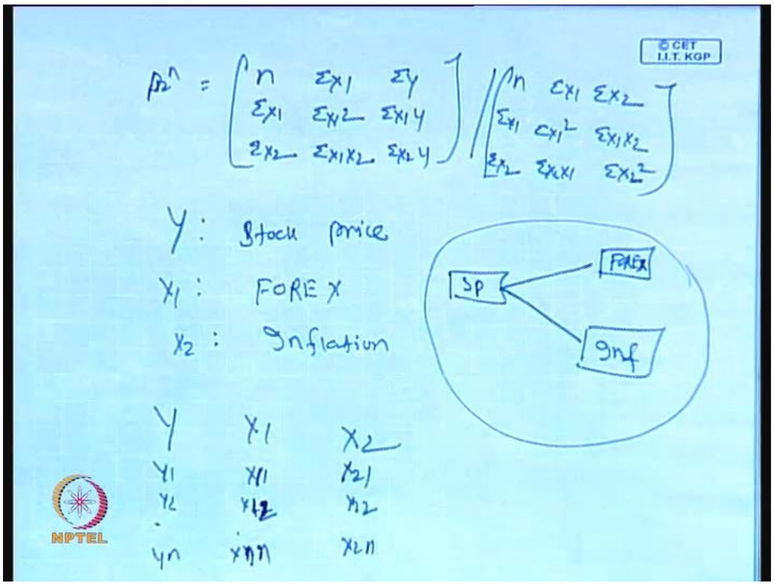


So, now practically we will take that let us say Y is a stock price Y is a stock price then X 1 is nothing but forex then X 2 is nothing but you can say inflations inflations. So, here our agenda is, this stock price stock price is has to be integrated with integrated with forex integrated with a forex then inflations. So, I will call it i n f.

So, now this this idea is here. So, to know how much influence forex forex influence on ~~s~~ stock price and how much inflation influence on stock price, this is how the this is this is one of the typical examples under Trivariate modeling, because you know stock price is a component which can be influenced by multi number of variables and at a particular point of time it is not possible to identify or it is not possible to represent. So, many variables altogether, with respect to our specific problem or you know suppose Trivariate Econometric Modelling is concerned we are just restricted this stock prices versus forex and inflation.

So, now if we use the statistical software then obviously, in three different columns you must have a information's. So, like this. So, we have Y X 1 and X 2. So, corresponding we have already uh you know identify what is Y what is X 1 and what is X 2. So, now you must have information like Y 1 Y 2 up to Y n similarly X 1 X 2 up to X n then sorry X 11 X 21 X x 11 X 21 X n1 otherwise you can put X 11 X 12 X 1n. So, that is better. So, this is also X 21 X 22 up to X 2n, this is how the representation is all about.

So, that means, we must have a sample information with respect to stock price with respect to forex and with respect to inflations. So, now we like to know what is the variation of you know forex and stock inflation on stock price of this particular you can say sample observations. So, now when we handle this particular problem through any statistical software then in each there are three columns in a particular setup. So, three column may be stock price you know forex and inflation. So, there is no hard and first rule that we have to start with first of price entry then inflation entry then forex forex entry. So, it is not a hard and first rules you take any variable entry in sequence.

Then since we have already designed here models where stock price is dependent variable and forex inflation are independent variable then obviously, so we have to when we will go for this statistical software use then we have to just give a command what is the dependent variable. So, if we will give indication to stock price dependent variable then; obviously, other two variables we have to put it in independent variables structure then altogether you automatically get the beta 0 hat component beta 1 hat component and beta 2 hat component.

So, now beta 0 the estimated value of these are all estimated values of beta all beta like beta 0 hat beta 1 hat and beta 2 hat. So, now here beta 0 hat is represented as a supporting component that is what we will call is a intercept bivariate model. So, beta 1 is the influence of you know let us assume that X 1 is forex then it is influence supporting component you know forex to stock price similarly beta 2 hat is the influence of inflation to you can say stock price that means, beta 1 beta 2 is the weightage factor the influence factor to this stock price.

So, now this is very easy when we will handle the software, but in the time being when we are in the class room problems. So, you you may not allow you may not be allowed to you know go through any statistical software of course, what you can do at best you can use excel sheet for you know for your simplicity. So, suppose a class room problem is concerned. So, there are two ways you have to handle very quickly some tricks you have to apply and second thing either you can use supporting component excel sheet or you can say rather supporting component say any scientific calculators.

So, let us assume that you are in the class room then how quickly you can uh finish this particular process. So, we have already discussed what is the entire structure of beta 0 hat beta 1 hat and beta 2 hat and further simplified to make it more quickly. So, we will transfer this structure into other different format. So, let us let us highlight that issue first then we will move to further structures.

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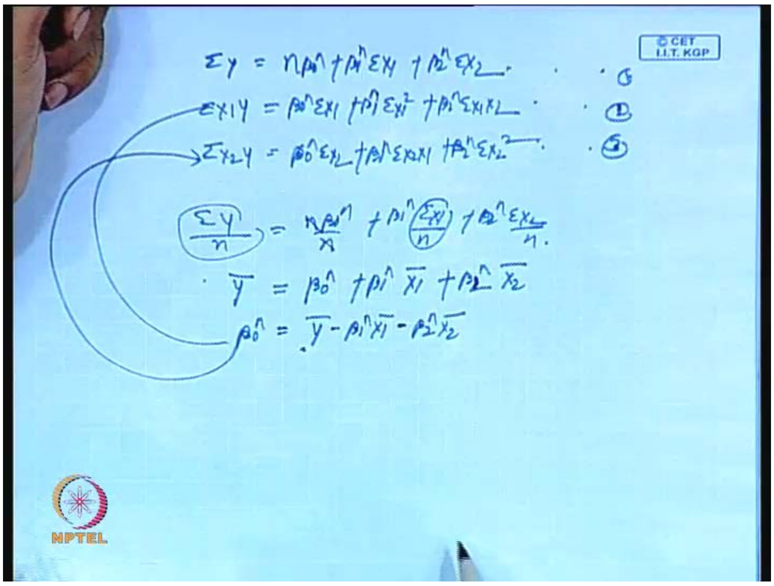


So, what we have received three equations summation Y a summation Y equal to n beta 0 hat plus beta 1 hat summation X 1 plus beta 2 hat summation X 2 then summation X 1

Y equal to beta 0 hat summation X 1 plus beta 2 beta 1 hat summation X 1 square plus beta 2 hat summation X 1 X 2 similarly summation X 2 Y is equal to beta zero hat summation X 2 plus beta 1 hat summation X 2 X 1 plus beta 2 hat summation X 2 squares. So, this is how we we have three different equations this is altogether three different equations.

So, now what you have to do like you know in the bivariate bivariate regression model. So, we have also two equations because there are two parameters in that particular structure. So, what we did in the bivariate structures. So, in the first equation you divide n both the sides then you know very easily you will get this you know supporting component intercept you know estimate value. So, that is beta 0 hat and that case it is alpha hat.

So, what you have to do. So, you have just here we have to just you know divide n both the sides. So, now if we will divide both the sides that is then summation Y by n equal to n beta zero hat divide by n plus beta one hat summation X 1 by n plus beta two hat summation X 2 Y n you know here n represents number of sample observations.

So, now if we will simplify then this summation Y by n is equal to Y bar Y bar this n n cancels. So, it will give you beta 0 hat plus beta 1 hat summation X 1 X 1 by n is nothing but X 1 bar then beta 2 hat is summation X 2 by n is nothing but X 2 bar. So, this is how you know transformation. So, now we need beta 0 hat. So, beta 0 hat is nothing but Y bar minus beta 1 hat X 1 bar minus beta 2 hat X 2 bar beta 2 hat X 2 bar uh this is we will get beta 0 hat.

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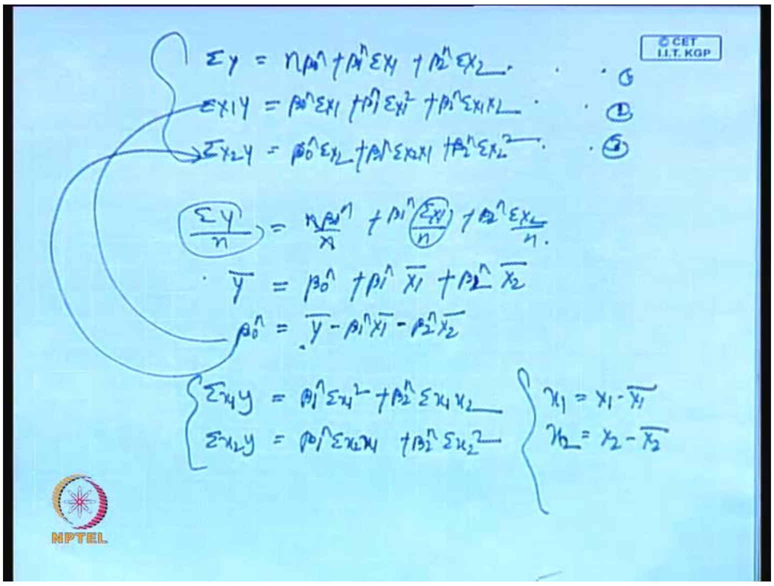


Then what you have to do we need to calculate the beta 1 hat and beta 2 hat. So, now if we will put this particular equation in equation number two now using this particular structure in equation number one, and equation number two and you simplify this particular equation two and equation three you will get simply summation X 1 Y is equal to beta 1 beta 1 hat summation X 1 square plus beta 2 hat summation X 1 X 2. Similarly, summation X 2 Y is equal to beta 1 hat summation X 2 X 2 X 1 plus beta 2 hat summation X 2 square. So, there is difference here this is another structure this is another means this is first structure and this is second structure.

So, in this particular structure the variables are in deviation format that means, here X where X 1 X 1 represents X 1 minus X 1 bar then X 2 deviation X 2 is nothing but X 2 minus X 2 bar. So, similarly with the help of this we can calculate the summation X 1 square; that means, it is nothing but X 1 into X 1. So, similarly if we will multiply X 1 and X 2 you will get the summation X 1 and X 2.

So; that means, what is this specialty is that. So, when there are means when you are in the class rooms and if you have a you have a Trivariate problem. So, first agenda is to have the simple structure means you have X 1 X 2 X3 sorry you have Y X 1 or X 2. So, you you very quickly you can have summation Y summation X 1 summation X 2. So, like this just ~~I~~I will highlight here.

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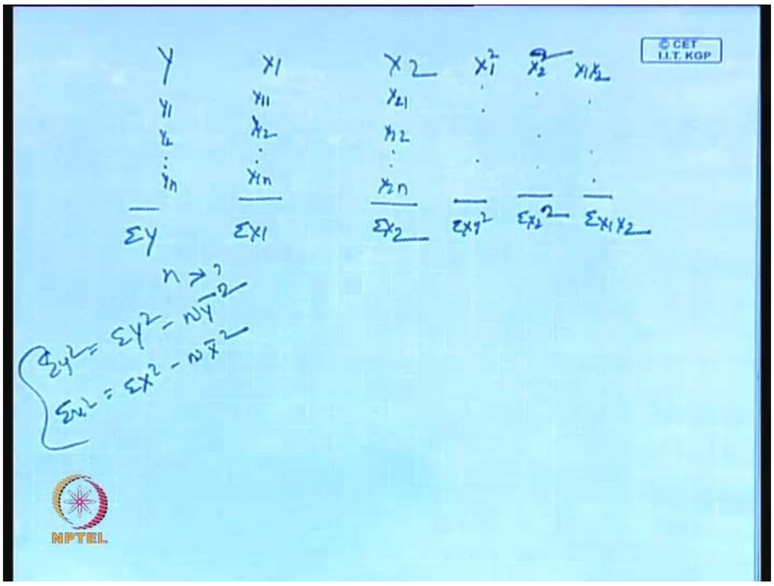


So, now you have the sample set of like this Y equal to Y X 1 and X 2. So, corresponding to Y you have Y 1 Y 2 up to Y n this is corresponding to X one. So, you have X 11 X x 1 2 then X 1n, so corresponding X 22. So, you have you have X 2 X 21 X 22 then X 2 n . So, now quickly what you have to do you will find out here summation Y summation X 1 then summation X 2 and obviously, n must be known known to you.

Then then again very quickly you have you must have another column X 1 square then you have must have column X 2 square then you have X 1 and X 2. So, these are the essential requirement so; obviously, there is some items here. So, it will process all these items then there is  this gap can be filled up by this information only. So, if you will if you will put all this in excel sheet very quickly we have to receive all these items.

So, now what is the what is the idea behind this setup. So, idea behind the setup is to have this is summation X 1 square then summation X 2 square then this is this is you know this is not X 2 bar this is X 2 square then this is summation X 1 and X 2. So, now either you have this first then you transfer into deviation format like you know summation we have summation Y square like this summation Y square equal to summation Y square minus n Y bar square, so like you know summation X square equal to summation X square minus n X bar square. So, this is what we have already drawn in the case of bivariate analysis.

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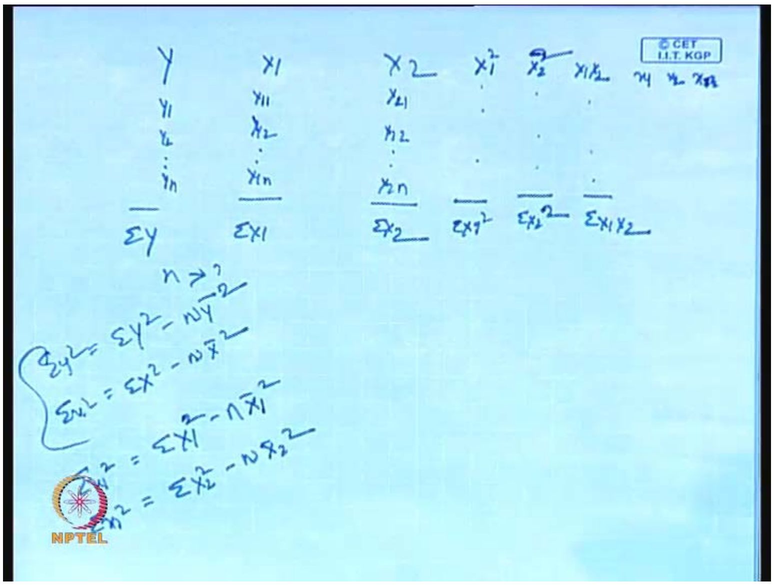


So, similarly we can also have here. So, here instead of you know here we have the format summation X 1 square. So, X 1 square. So, it is nothing but summation X 1 square minus n n and this is X 1 X summation X 1 square minus n into X 1 bar square. So, this is how we have to derive similarly summation X 2 square is nothing but summation X 2 square minus n X 2 bar square. So, this is how we can transfer all these issue.

Otherwise the second procedure is you you have another columns like you know this is small X 1 this is small X 2 this is you know X 1 X 1 X 2 alright this is X 1 and X 2. So, this this you know this this you take X 1 square this you will take X 2 square; that means, it is the question of X 1 into X 1 X 2 into X 2 then X 1 into X 2. So, this X 1 is nothing but X 1 minus; that means, this is nothing but X 1 minus X 1 bar. So, now you have to create a column small X 1 that is deviation X 1 which is nothing but the difference between X 1 minus X 1 bar. So, you first create that particular column then again that column if we will multiply with the same element again then you will get X 1 square.

Similarly, we will create X 2 small X 2 then you multiply again with that small X 2 you will get X 2 square. So, now you have to multiply X 1 small X 1 into small X 2 you will get this sequence X 1 and X 2 then you get the summation all these items. So, the moment you will get all these item then the problem is little bit simpler.

So, for the as usual in the bivariate structure in this trivariate structure it is better to have first beta 1 hat and beta 2 hat then you use that beta 1 hat beta 2 hat in first equation where beta beta 0 hat equal to Y bar minus beta 1 hat X 1 bar and minus beta 2 hat X 2 bar. So, the moment you will use beta 1 hat and beta 2 hat in that particular equation. So, you can able to get the beta 0 hat.

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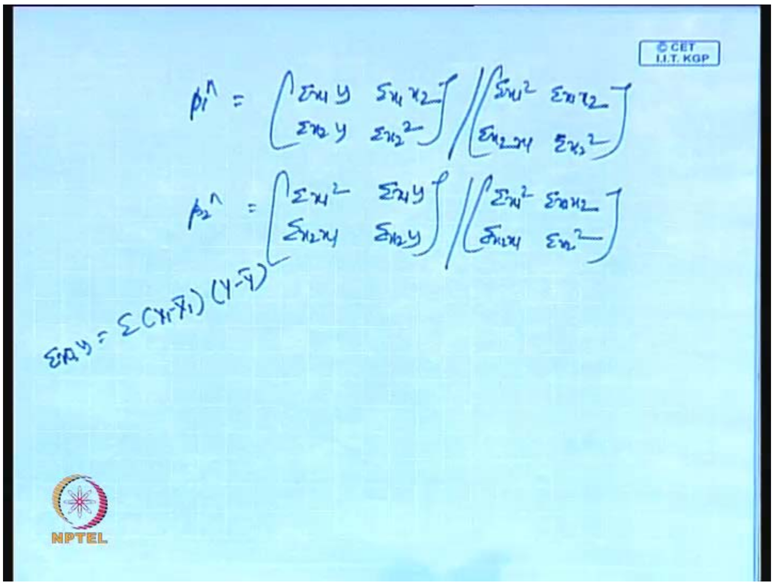

So, the first and prime condition in this particular process is to have the beta 1 hat and beta 2 hat. So, now if we will simplify the deviation format then you know the beta 0 hat calculation is little bit more easier. So, now if you'll apply this particular equation means this particular setup is here. So, if you'll simplify this particular structure then ultimately. So, beta 1 hat beta 1 hat is equal to summation summation X 1 Y summation X 2 Y then summation X 1 X 2 then summation X 2 square. So, these divide by summation X 1 here summation X 1 X 2 then summation X 2 X 1 and summation X 2 square. So, this is how the derivation of beta 1 hat.

Similarly, beta 2 hat is equal to summation X 1 square summation X 2 X 1 then summation X 1Y summation X 2y. So, this divide by as usual summation X 1 square summation X 1 X 2 summation X 2 X 1 summation X 2 square. So, this is beta 2 hat.

So, now here; obviously, summation; that means, the in the note you you have to write like this summation X 1Y is equal to summation X 1 minus X 1 bar minus X 1 bar into Y minus Y bar this is how you will get the summation X x 1 Y 1 or you have to apply the deviation formula. So, directly you can asses so; that means,. So, you have actually Y X1 and X 2 this is what we call it original information and can be represented in the form of capital Y capital X 1 and capital X 2.

So, then if you do not like this deviation format or if you are not able to remember this deviation format. So, in excel sheet you create you know three other variables like small Y small X 1 and small X 2. So, small Y is represented a deviation format. So, small Y represents Y capital Y minus capital Y bar similarly small X x one represents the deviation of X one. So, that is a capital X 1 minus X capital X 1 bar similarly for X 2. So, it is deviation X 2. So, it is the difference between X 2 capital minus X 2 bar capital. So, then you have three different columns X 1 bar deviation of X 1 bar deviation of X 2 bar sorry deviation of X 1 deviation of X 2 and deviation of y.

So, now as for this requirement of this particular structure, you you have to you have to calculate or you have to you know add another column sequentially. So, that is the X 1 into Y is another column X 1 and X 2 is another column then X 1 square is another column then X 2 square is another column then X 2y.

So, now once you have this columns then finally, you take summation of all these columns then accordingly you will apply you will get the you know final matrix then after that it will solve that particular matrix you can able to know what is beta 1 hat beta 2 hat and using this beta 1 hat and beta 2 hat you will get this you can say beta 0 hat beta 0 hat equal to Y bar minus beta 1 beta 1 hat X 1 bar minus beta 2 hat X 2 bar. So, X 1 X 1 bar X 2 bar you can directly you know asses from the original samples because it is summation X 1 by n and summation X 2 by n.

So, once you follow this estimation process and after that getting this you know beta 0 hat beta 1 hat and beta 2 hat. So, now we are you know position or next you know step we have to represent the the information about the estimated models. So, how you have to represent the complete information of the estimated models, as usual you know bivariate structures.

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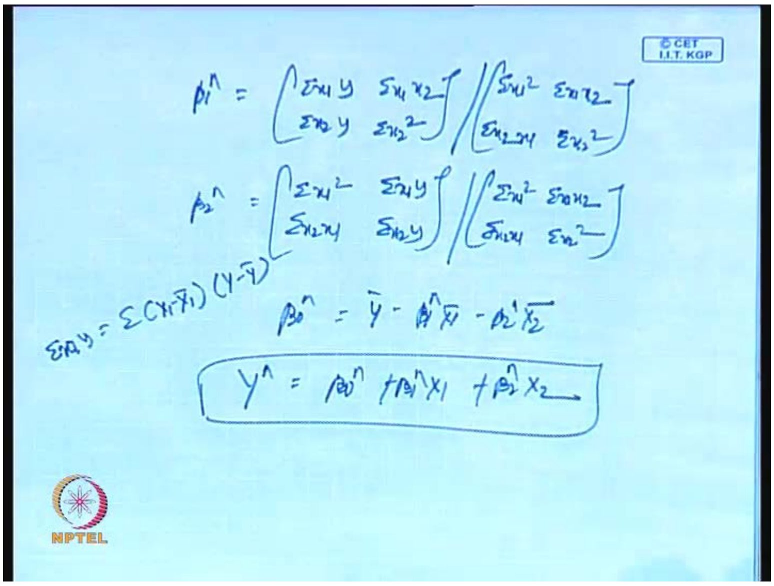


So, here the moment you will get the estimated model here like this. So, Y y hat equal to beta 0 hat plus beta 1 hat X 1 plus beta 2 hat beta 2 hat X 2. So, this is this is our estimated model where beta 0 is followed is beta 0 is followed by this equation and beta 1 hat followed by this you know matrix and beta 2 hat is followed by this particular matrix.

So, now after getting all these you know values estimated values for beta 0 hat beta 1 hat beta 2 hat. So, then again you like to go for its testing. So, that is what we call it a reliability testing so that means, here again our agenda is to know whether this particular estimated model is the best fitted or or not.

So, now to know the best fitted model or you can say good estimated model. So, now we have to go for reliability test. So, now there are two different test here. So, one test is with respect to specification test and another is related to goodness fit test.

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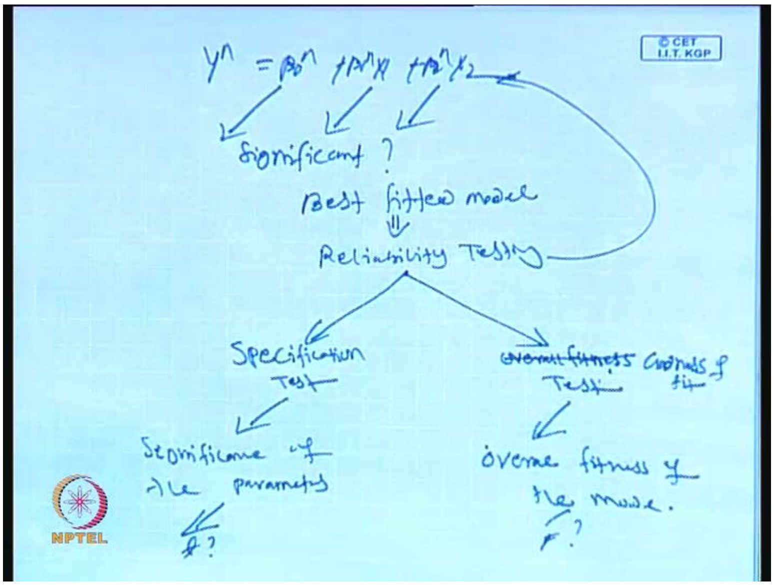


So that means, the structure is like this. So, the moment the moment you will get get this equation Y hat Y hat equal to beta 0 hat plus beta 1 hat X 1 plus beta 2 hat X 2. So, then your objective is to know whether this is significant this is significant or this is that means, here we like to know whether they are significant significant, so that means, significant is question mark here.

So, we like to test whether the the you know parameters obtained by using the information and techniques information are significant or not so that means ~~So,~~ the moment. In fact, there are two specific objectives first objective is to know the significance of estimated parameters and second objectivity to know the overall fitness of the model. So, that that means, so far as a best fit model is concerned best fitted models you have to you have to know the best fitted models you have to go for reliability reliability testing reliability testing of the reliability testing means with respect to this estimated models.

So, now reliability testing has a two different specification here one is called as uh specification test specification test with respect to parameters specification test and another is called as a overall fitness test. So, this specification test this particular structure indicates the significance of the parameters specifications test objective is to judge significance esignificanc of the parameters significance of the parameters.

Then in the case of overall fitness of the model here the objective is to know the overall overall fitness of overall fitness of the model. So, this means this is otherwise known as actually it is not over all fitness of the model it is a goodness fit model. In fact, instead of putting of overall fitness test is you can say goodness of fit test; that means, goodness of fit test so that means, we like to observe here overall fitness of the model. So, this is how the second objective second objective of this particular you know reliability testing, so as far as significance of parameter is concerned like our bivariate setup.

So, we have to apply t statistics and again you know in the case of overall fitness of the model we have to use f statistics. So, now this is this you need the t statistics this you need f statistics. So, before we highlight the entire structure of the specification test and overall fitness of the model, let me first highlight the two different tables one table will be related to the estimated values that means, estimated information about all these parameters and second table digit that is anova table that is which means that will indicate the overall status of the model or overall fitness of the model.

So, now here the estimated information will give you the indication about the you know exact influence of that particular variable to the dependent variable that means, what is the weightage of X 1 on Y and what is the weightage of X 2 1 Y and in the same times we have to see whether X 1 the influence of X 1 on Y this statistical significant and that is observed through beta 1hat and similarly in the case of X 2 what is the influence of X 21 on Y is significant or not, so that is you know observe through beta 2 coefficient means significance of beta 2 coefficient.

So now, we have to see how quickly they are significant or you know what extend they are significant so that means, we have to design in such a way or we have to restructure in such a way that the parameter should be statistical significant at the highest level that we can say that it is one percent so; that means, the moment we have that type of objective for specification then; obviously, the overall fitness of the model that is represented by r square followed by adjusted r square and tested by f statistic should be also statistical significant at one percent level.

So; that means, the in the case of Trivariate Econometric Modelling. So, we expect that the way we will design that particular estimated we expect that the parameters with respect to beta 0 hat beat 1hat beta 2 hat should be statistically significant at least at one percent level and in the same times the overall fitness of the model judged by r square and tested by f should be also statistically significant at 1 percent if that is the case then you know that that Trivariate model is you can say can we consider as a best fitted model and can be applied or utilized for forecasting or for issues.

So, now to go all these details about this specification, let me highlight here what is the estimated information about this Trivariate Econometric Modelling, that means, what what sort of things we need to have to go for this reliability test with respect to parameters and with respect to the overall fitness of the models.

So, let me highlight what is the sequence or what are the means, the way we have to represent the final structure of the estimated model. So, you know if you do not like to put it in a tabular format you can put it in a also model format or you can see equation format and followed by it has to be structured in such a way that the entire tabular information means the entire estimated information can be you can say judge or establish through the equation either through the equation or through the table.

So, depending upon you know interest or you know choice or observations. So, you have to use any one. So, that is not hard and first rule, but the a structural sequence sequence or you can say representation of all the information's should be very systematic and you know as usual it will follow the structure and setup

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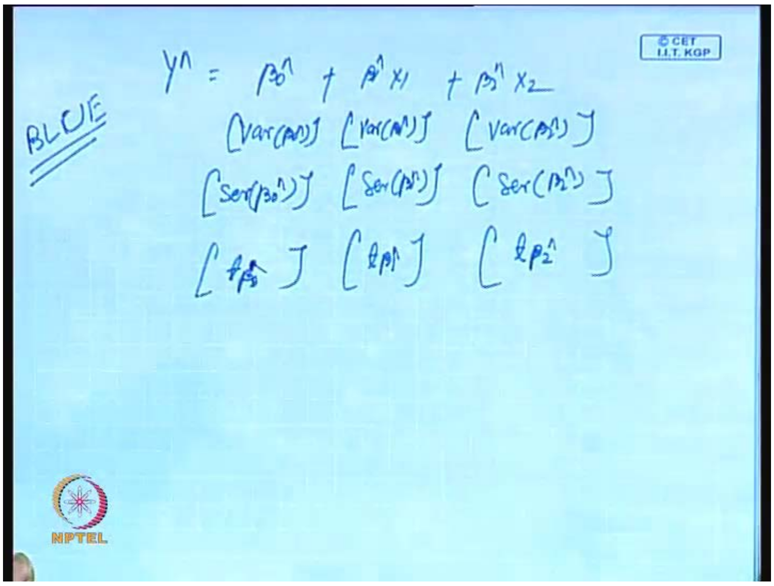

So, now Y hat is equal to beta 0 hat plus beta 1 hat X 1 plus beta 2 hat X 2. So, now this is the estimated model which we have derived from the original econometric models Y equal to beta 0 plus beta 1 X 1 plus beta 2 X 2 plus the error component after you know process or application of wireless technique we have received this beta 0 hat beta 1 hat and beta 2 hat where beta 0 hat has a some statistical formula beta 1 hat some statistical formula and beta 2 hat a some statistical formula which we have already discussed.

So, now how we have to do means how we have to go for this reliability parts that means, in the first suppose reliability or reliability testing is concerned with respect to parameter then obviously, we need to know what is the variance of all this parameter. So, you know we have discussed couple of days back the term called as a blue best linear unbiased estimators. So, the term called as a blue best linear unbiased estimator so; that means, whatever beta 1 beta 2 beta 1 beta 2 hat you have. So, these these parameter estimated parameters should have some you know sample properties means it should follow some sample properties that means, it is it is through blue theorem. So, best linear unbiased estimator.

The moment you will go to touch this theorem properties then by the way you will get all these information so that means, here you need variance of beta 0 hat this is known as variance of beta 0 hat then you must have variance of beta 1 hat then you must have variance of beta 2 hat variance of beta 2 hat.

So, corresponding to variance of beta 0 hat you must have standard error of standard error of beta 0 hat then standard error of beta 1 hat then standard error of standard error of beta 2 hat, so far corresponding to standard error. So, you need to have calculated t statistics t beta 0 hat t beta 0 hat then this is t beta 1 hat. So, this is t beta 2 hat this is t beta 2 hats.

So, now after getting you know this t beta 0 hat t beta 1 hat and t beta 2 hat are represented as a calculated t statistics the moment you have calculated t statistics. So, then as usual you have to compare with the tabulated statistics with the you know with the available sample information and you know uh with respect to the degrees of freedom because the degree of freedom here depending upon the a sample observation and number of parameters in the system since in this particular in this particular setup. So, here here the representation degrees of freedom is represented as a n minus k.

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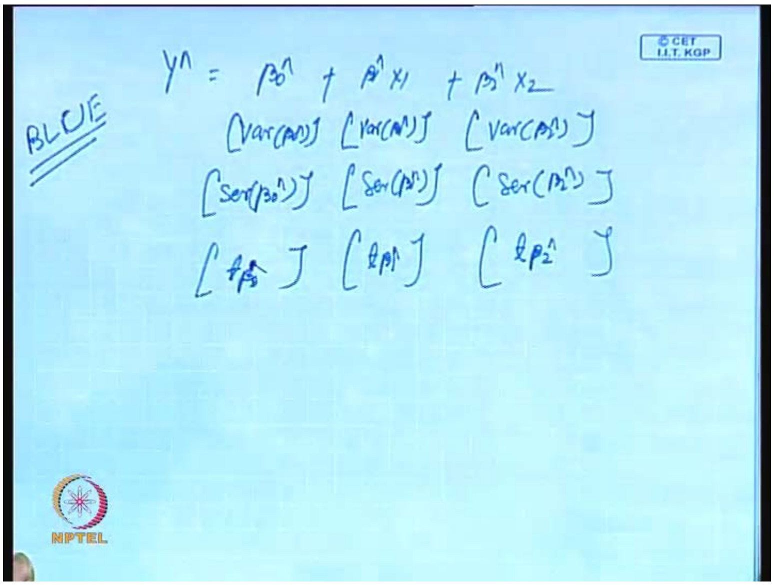


So, here n represents number of sample number of means sample size number of sample it is better to put sample size this is sample size and and k represents number of parameters number of parameters in the systems or you can say number variables in the systems so that means, in this particular sequence or in this particular problem means in the Trivariate structure k represents three k represents three k represents three means since there are three variables in the system or three parameters three parameters involved in this estimation process.

So, now with the help or that means, the number of parameters number of parameters which is represented by k is known to us in this Trivariate setup. So, we just we have to just check it what is the sample size. So, with respect to sample size and with respect to degrees of freedom we can have the tabulated statistic with different level of different probability level of significance.

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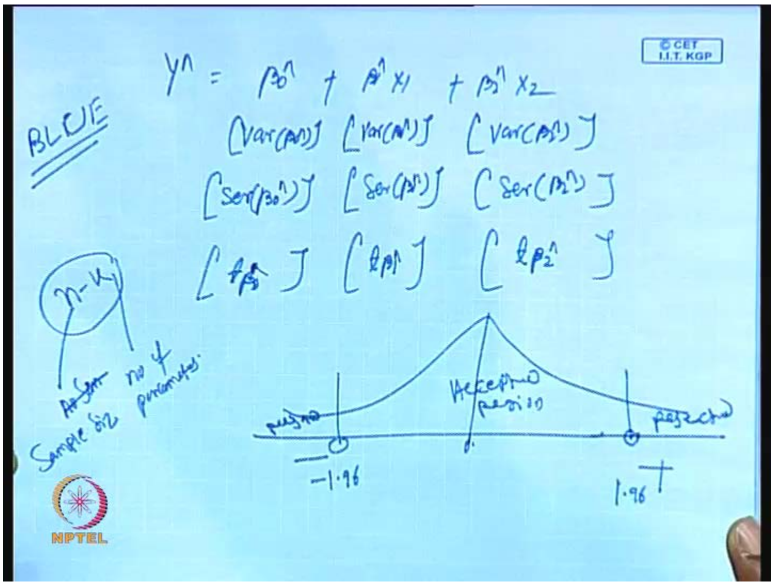


So, accordingly we are in a position to justify whether particular item is statistically significant or not for instance again we have to go for this you know 1 tailed test or 2 tailed test right tailed test or you can say left tailed test like this. So, this is how we have to receive this means we have to compare the setup. So, let us assume that this is the critical region this is accepted regions this is accepted regions. So, as usual, this is the origin. So, now if we will go by you know two tailed test then you know this side is minus and this side is plus. So, now we we like to have first tabulated statistics. So, let us assume that this tabulated statistics is 1.96 and this is minus 1.96.

So, now with this particular tabulated value sorry calculated value then you have to look at where where it can be possible to set. So, now this is rejected region. So, this is rejected region and this is also rejected regions. So, this is as usually you know very similar to bivariate analysis the only difference is here you know the matrix format that is three into three orders where in the bivariate format it is in the order of two into two. So, that is why it is little bit complex and the formalize little bit different bivariate, but the structures setup is almost all same.

So, now the moment you have then just locate it you corresponding you know more or less sample information is same means obviously, this you know significance at the tabulated statistic value will more or less same. So, you have to just check it what is the calculated value of beta 0 hat beta 1 hat and beta 2 hat that t statistics. So, now you represent accordingly.

So, now if you, if it is coming this side or this side then obviously, you have to reject this null hypothesis that means, before you go for you know calculating all this t statistic then you have to set the hypothesis that null hypothesis that beta 0 hat equal to 0 beta 1 hat equal to 0 and beta 2 hat equal to 0 then we have to reject the null hypothesis that beta 0 is not 0 it has substantial or significant value which can built the you know built the fitness of the model or that fitness of the model can be you can say use for forecasting or for issues.

So, what we will do in the next step. So, we will take a simple example then we have to go for this particular testing. So, whether this you know means what how quickly we can have this or we can check the significance of the parameters for Trivariate modelling and in the same times how is this setup and structure of the a anova that is analysis or variance since we have no time now. So, this particular process we will do in the next class with this, we have to conclude this particular session.

Thank you very much, have a nice day.