Engineering Econometrics
Prof. Rudra P. Pradhan
Vinod Gupta School of Management
Indian institute of Technology Kharagpur

Lecture – 04
Introduction to Engineering Econometrics (Contd.)

Hello everybody, this is Rudra Pradhan here, welcome to Engineering Econometrics and today we will start our 4th lecture and that to Introduction to Engineering Econometrics. Let us have a have an a overview.

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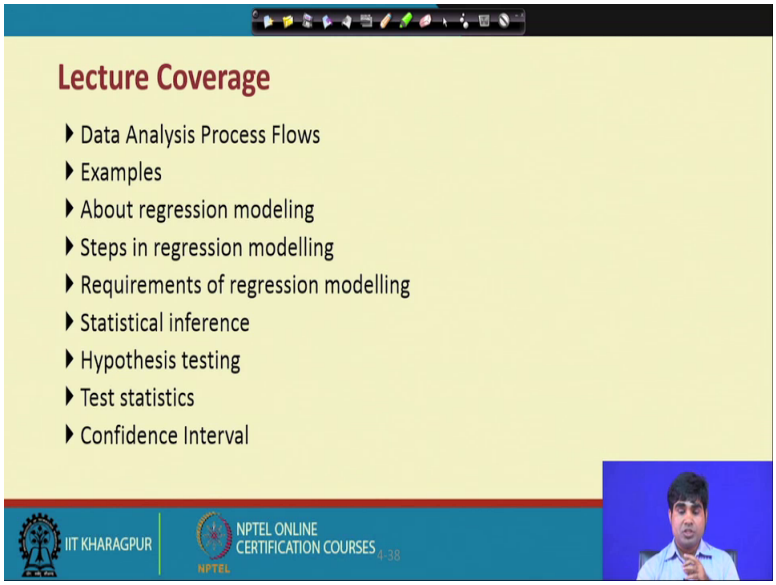

So, the coverage of this lecturer will be like this, we will be start with the data analysis process flows, then some of the examples where we can apply the engineering econometrics; then what I have already pointed out the earlier that you know the entire package the entire subject more or less actually acquainted with the regression modelling. So, we will give you know some kind of you know structural framework about the regression modelling in this lecture.

So, starting with the a basics about the regression modelling, steps of regression modeling, then the kind of in the requirements then some statistically inference at these testing test statistics confidence interval. So, these are all so some kind of you know requirements in the process of you know engineering econometrics. So, let us first start with you know on data analysis process flows.

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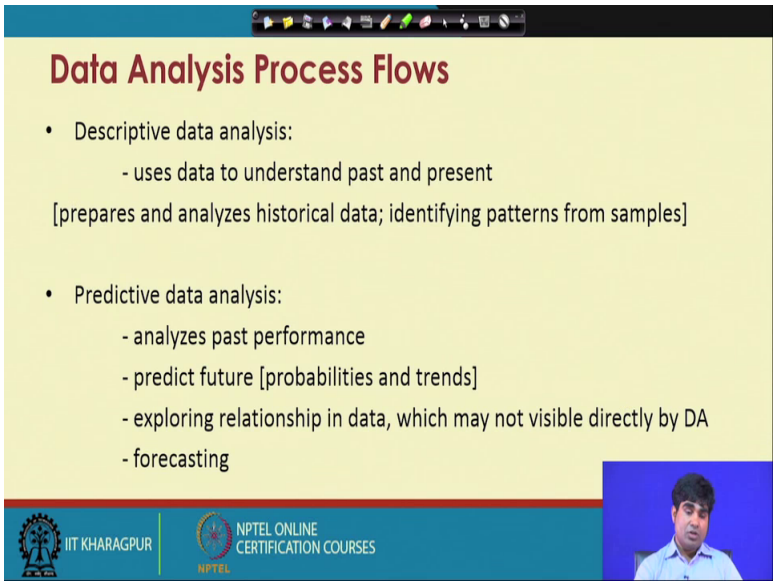

So, we have you know we have a subject you know called again on data analytics. In fact, you can find you know plenty of you know you know lectures on data analytics with you know different subjects, basically if you will go by you know data analytics. So there are you know for different ways you can actually start the process; Descriptive analytics, inferential analytics, predictive analytics and prescriptive analytics.

But this particular engineering econometrics is a kind of you know quantitative a subject; that means, it is more or less you know connected with the quantitative analysis. So that means, technically it is also like you know analytic subjects, where we will not actually cover all these for analytics tools here. So we will be touching upon more or less predictive analytics. However, the fundamental requirements of predictive analytics is that you know you must have the information about the descriptive analytics and the inferential analytics.

So, when we will dealing with the problems related to predictive analytics, that means mostly predictive techniques and then by default you are bound to know you are supposed to know the descriptive analytics tools and inferential analytics tools, because these are the mandatory requirements for predictive analytics. So, in the case of you know in the case of you know descriptive you know data analytics, which in engineering econometrics we call as you know descriptive data analysis structure.

So, the idea behind these descriptive data analysis or you know descriptive data analytics is that, so we can use the data to understand the past and you know present situation. So that means, you know it is a when you are dealing with any kind of you know data to address some of you know engineering problems, so the data itself will give you some kind of you know inference. So, by looking the kind of you know data, so you will get to know certain things, but again is the same data can give you give you some kind of you know different a inference or a different kind of you know clue when you are you know connecting with you know other data friends in a kind of you know functional mode.

So, that is how so you must be very careful how to dealing with all these kind of you know structuring. So, one of the way to understand the or the handle the situation is called as you know descriptive data analysis and at the second one is called as you know predictive data analysis. So, while doing predictive analytics and data analysis, so inferential analytics by default will be there in the system. So, in the predictive data analytics a we like to do here the analysis with respect to past performance, and then we like to actually do for some kind of you know prediction about the future.

So, basically we are since it is a kind of you know regression modelling structure which I have already mentioned many times and so the one of the objective behind this particular subject is a exploring the relationship among the variables and that a relationship; that means, the degree of relationship you know varies from the data to data, so how much degree of you know relationship your association is there. So, the data can I tell you the actual facts.

So that is why data is one of the fundamental requirement of this particular you know engineering econometrics process. So, altogether so in this engineering econometrics we are not dealing with you know all kinds of you know analytics, but we specifically focusing on you know predictive analytics and by the way, while doing predictive analytics we are suppose to touch upon the descriptive analytics and inferential analytics.

How is the process flows or you know the kind of you know processing, so over the time you will get to know in details right. So and a the end part of you know predictive analytics or you know predictive data analysis is nothing but you know go for forecasting. So, forecasting means actually read the first pattern and the present pattern and then we look for the a look for the future trend. So, a indicating future trend with the

current situation or past situation is nothing, but the signal of you know forecasting. We have a separate lecture about the forecasting. So, we will discussing details what is the kind of you know structural the kind of you know requirement while doing the forecasting and that to in the part of the a predictive data analysis structure.

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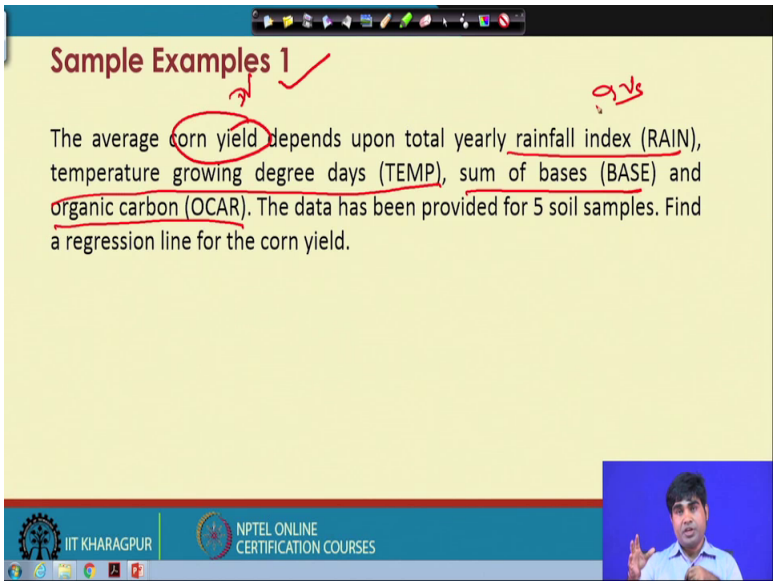

So, now with the data analysis you know process flows, so what you can do that you know in the first lecture itself you now we have actually clearly highlighted that you are we will be dealing with you know number of engineering problems, and all these engineering problems may not be a particular engineering field like you know civil engineering or mechanical engineering.

Since you know many people's are you know coming into this particular you know subject, so we may have means we are assuming that you know everybody has a different kind of an expertise or a different kind of knowledge less. But you know whatever possible try to pick up you know different problems under you know different situation, then like to address this a address the kind of you know issues. So, ultimately it is a quantitative techniques kind of you know structure, so knowing the techniques so you have to pick up the area of where you can actually apply. So, now some of these heighted examples I am just highlighting here.

So, for example in the this is the a this is your case 1. So, where so the issue is actually average corn yield depends upon total yearly rainfall index, temperature growing

degrade days some of bases and the organic carbon. So that means, it is a agricultural engineering problem, here the idea is to predict the you know yield of the corn and a that depends upon many variables and this is the corn yield is nothing called as you know dependent variable, where when you know will be applying you know regression modelling that to ergonometric modelling.

So, this is the dependent variable structure and then we have rainfall index, then temperature than the sum of bases and the organic carbon. So, these are all called as you know independent variables. So, then regression modelling is a some kind of you know functional relationship between dependent variable and independent variable, and ultimately next objective is to find out which variable is having high impact and which variable is having low impact and which variable having no impact at all.

So, about the process we like to you know we like to know all these details and there is a systematic process all together and a the completely not step by step process. Till we get the kind of you know results and (Refer Time: 08:56) kind of you know remarks and comments or the kind of you know outcomes as per year you know particular you know objective requirement or you know engineering requirement is requirement.

So, likewise you can apply you know different engineering a areas you know, so that means, technically just you have to pick up a engineering problem, where the problem can be a you know highlighted with the help of you know full of variables we are some variables, I will be identify as a dependent variable and some variable identify as you know independent variable.

So that means, there must be theoretical understanding theoretical connections everything will be there in the kind of you know structure, then econometrics will be help you to you know verify the particular structure or strengthen that particular structure you know with a kind of you know quantitative you know way. So, that is how the kind of you know process, likewise there is a another example here.

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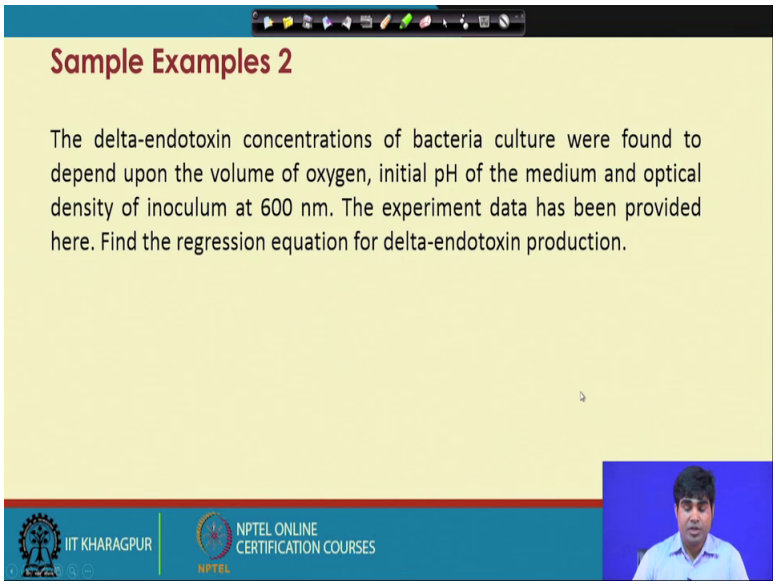

And the example is like you know and this is actually something similar kind of you know you know engineering problem and a here we like to again you know predict the dependent variables subject to independent variables, and delta endotoxin productions you know that is a another kind of you know you know issues.

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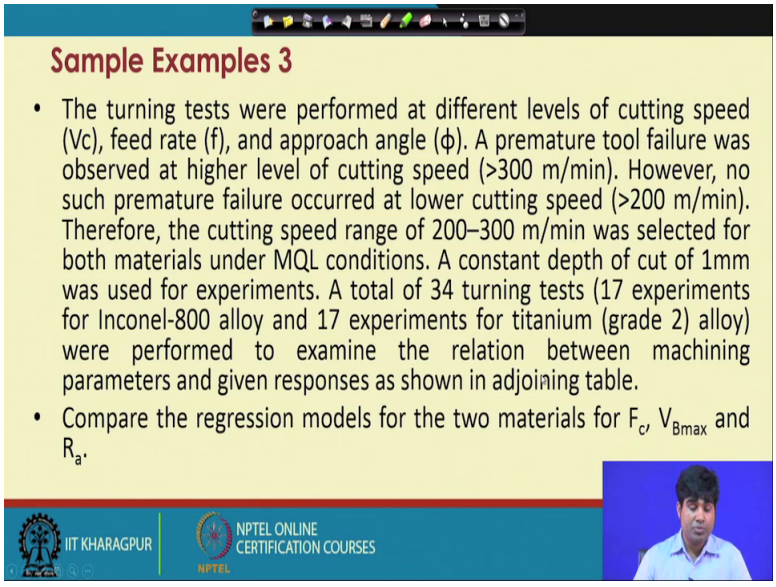

Similarly, there is a another engineering problem, which can against address through the regression modelling. So, I am just you now skipping all these problem so ultimately we like to see how is this process of you know modeling.

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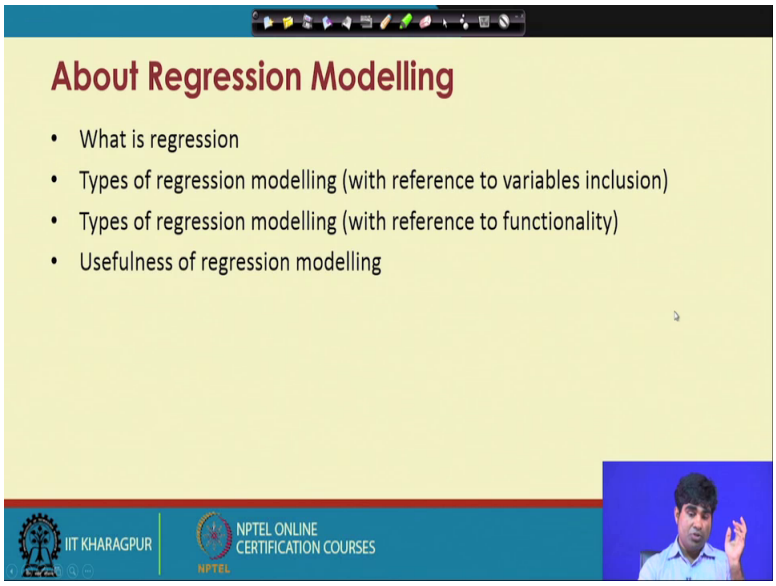

So, the idea about this lecture is actually to give you know snapshot or you know structural framework about regression modelling, because it is the one of the most important component for the a engineering econometrics. So, now in this in this particular you know you know lecture, so we like to just know what a what is all about the a regression modelling and we like to touch upon you know types of you know regression modelling that is with respect to variables involvement you know.

So, a starting with the one you know minimum requirement this is 2 variable and 3 variables 4 variables and so on. So, depending upon you know more number of variables the model complexity will start increasing and then a we like to know the types of regression modelling with respect to functionality and against we can go for you know type of regression modelling with respect to data structure for instance.

Using cross sectional data then regression modelling can be called as you know cross sectional regression modelling using time series data can be called as a time series regression modelling. Similarly, using panel data can be called as a panel data modelling and finally, a usefulness of you know regression modelling. So, these are the basic things we are suppose to you know address here and then we start with you know what is all about actually regression.

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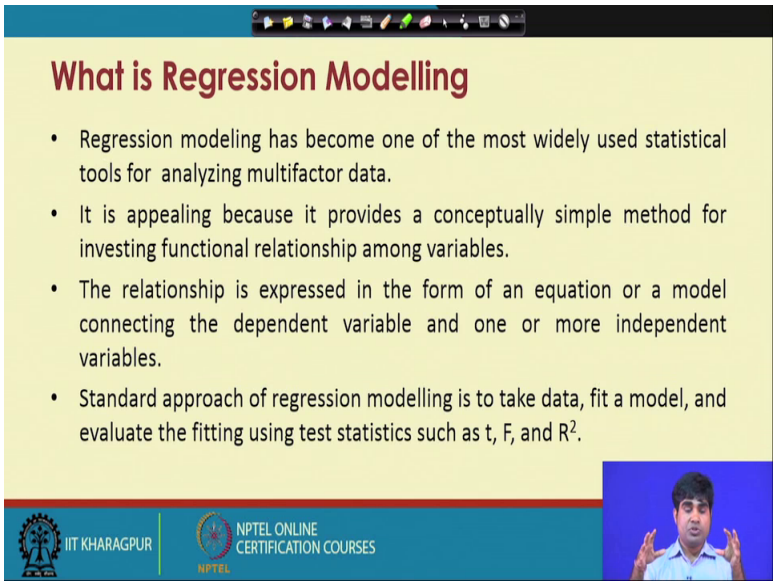

So, you know you will find you know plenty of definitions, you go to any you know statistics books or econometrics books you will find you know plenty of definitions. So, in some regression modelling you know become one of the most widely used statistical tools for analyzing multi factor data. And mostly you know it provides you know a conceptually you know simple method for investing functional relationship among variables and so that means while dealing with the personal relationship.

So, you must have a dependent variable and you must have a you know independent variable and a there should be a systematical you know connection between dependent variable and independent variable. The idea is you know how independent variable can influence the dependent variable, you know what extent and you know what degree that is the core objective behind this particular you know regression modeling.

And then we apply standard you know approach you know to the regression modelling you know it is the connection of you know regression modelling is to take data fit a model and evaluate the fitting use using various test statistics like t statistic, F statistics and the regression outputs like you know R sphere that is the coefficient of determination etcetera.

We will go in details about all these you know requirements, but in the mean time this is what is the process. If I if you if I like to you know summarize what is all about regression modeling, it is the game option dependent variable and independent variables

and the game will be the establishment of functional relationship, what kind of you know functional relationship will be very effective for a engineering problem and while a doing the functional relationship with the m is to predicted or to know what extend the independent variable influencing the dependent variable.

And in total since it is the cluster of you know independent variable with you one or many independent variables or something like that, then you may have a independent individual impact on the dependent variable a may be again overall the impact to the you know dependent variable. So, that is how so you can find out the partial impact and you can find out the total impact from the independent variable to dependent variable.

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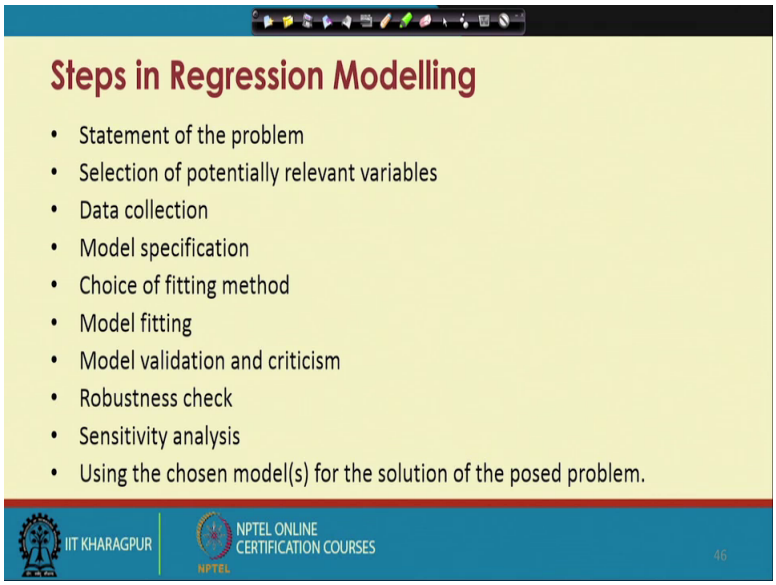

And so while you know doing regression modelling what I have already mention so, it is a kind of you know step by step process altogether and the step by step process is like that you know, you must have a statement of the problem that is derived through theory and then we will go for you know selection of potential relevant variables. So that means, the theory or problem can be addressed with respect to the some of the decision variables. Then we have a data collection, because corresponding to decision variables if are data or you know information is not available, so you are not in a position to analyze it.

That is why so you must have a structural to analyze the data you know or you know collect the data and then you go for you know model specification. On the basis of you

know data then what you have already mentioned in the previous lecture that you some of go for you know data visualization, because data visualization give you some kind of you know accuracy about the model specification whether you like to use a linear model or whether you like to use a non-linear model again in the case of non non-linearity, you will find different functional forms at their.

Because, regression modelling a outcome exclusively depends upon you know the accurate fit of the data and accurately fit of the functional form. So, if the functional form is miss specified and data is a miss specified, then the particular empirical process we will give you some kind of you know bias results and sometimes results may be very spurious to analyze for the engineering problem, then choice of fitting methods.

So, there are couple of methods are there, so I well you know doing the estimation process, like you know very standard ones are ordinary list square methods generalized list square method, it will list square method, generalized method, some remains. So, so many methods are there to you know fit the data for the kind of you know requirement , then that is what actually called as you know model fitting. So, once you fit the models and the to connect the theory with the data and get the a quantified or you know mathematical model.

So, we need to you know validate the models, how best this model can be useful for the particular you know engineering requirement. And this is again not the a very you know easy task and it is a 1 step process because, the model you know validation depends upon you know couple of you know tests. So, if the test you know if it means all these tests are not actually ok, then by default you have to actually very very investigate the process or re estimate the process till you get the kind of you know better results as per the particular you know a requirement.

So; that means, again some I think you know model validation is a very you know crucial step of this you know regression modelling, where you may proceed or you may go back against because, this is the turning point where it will give you a simple message this model is not a case. So, you have to go back again starting with you know again may be the problem with the data may be problem with model fix you know functional form or something like that and maybe the choice of you know particular technique like (Refer Time: 18:06) or something like that.

Then that means, technically if we the model validation is not ok, you have to start with you know I can start level if the model validation is then you how to proceed furthers right. So, in the as in that you know model is you know estimated model is it technically to analyze the engineering problem, then we can go for some kind of you know robustness check.

So that means, we will find some kind of you know various other alternatives for instance, a particular variables can be expressed you know differently. A for instance let us say in a international trading, so there is a concept called as you know trade. So, we like to study the impact of trade on you know countries output or countries income.

So, in that case the trade can be a can be use like you know total trade then there is a concept called as a trade operation, then it can be use as you know expert import ratio or it can be use is like you know simple exports or it can be use as you know a you know difference between export and a import that is called as you know balance of trade. So that means, there are all called as you know various robustness check in the process of you know empirical a you know estimation process.

So that means, your model may be you know anything, so we have no issue about the validation; so, just you know replacing the variables within a different variables, because all these variables will be specified the impact of trade. So, now you know that particular variable is having a different kind of you know a representation occurs the interpretation of these variables may be little bit different, but it automatically replace it is that you know it is the trade impact on the income. So, that is why so you have to check the robustness and then you have to fit the model against in which case the model is a actually coming very good result coming with you know very good results. So, you have to fix that models to you know represent or you know to highlight the engineering problems as per the requirement.

In fact, you know all the engineering problems where you know you know doing the empirical investigation. So, there may be less chance of you know checking the robustness say, but whenever there is a any kind of you know heat or you know possibility, it is better to check the robustness and then you fix the models as per you know particular requirement.

So that means model validation is one part and a again robustness check is the another part model validation depends upon different test through different test statistic and test procedure; robustness checks depends upon you know some kind of you know flexibility within the modelling structure and just you to allow these flexibility and check the results. Whether there is a any kind of you know difference with the existing a results. If there is the a difference and then you check whether this differ and newly a derived result is much better than the existing one, if it is the case then you can you can choose the newly one and then reject the other ones otherwise you can you can accept the previous one reject the new one. So, this again the kind of you know continuous process.

Then finally, we can go for some kind of you know sensitivity analysis by alloyings the variables with you know different kind of you know change and then with you know bivariate we can go for trivariate, you can go for you know multivariate kind of you know structure. So, again sensitive analysis will give you some kind of you know additional flexibility in the process of you know investigation and then finally, you know whatever you know mechanism a you know Apollo.

So, the student model should give you the kind of you know solutions as per the particular you know engineering requirement and then you will go for the kind of you know policy decision or kind of you know engineering decision as per the particular you know engineering a requirement.

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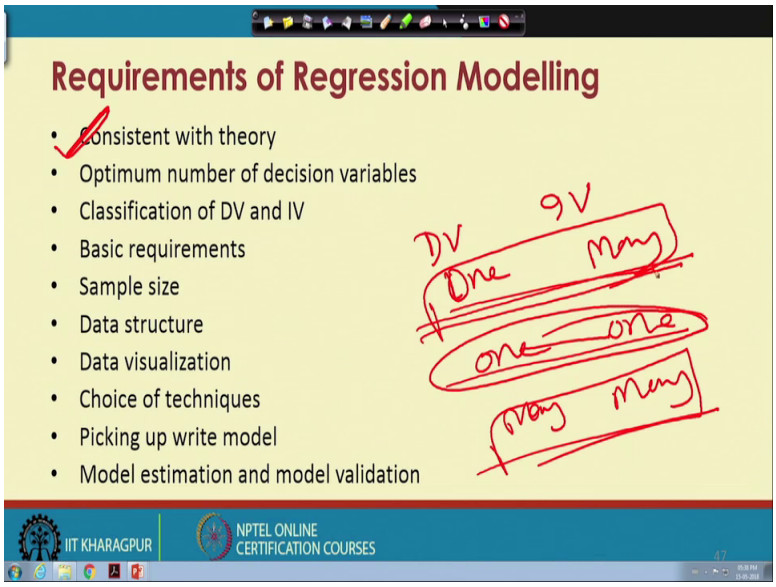

So, accordingly so in after knowing the kind of you know steps of regression. So, what I like to say. So, there is a kind of you know requirements while doing you know regression modelling. So, first requirement of the regression modelling is the there must be I means it must be consistent with the a theory. So, a suppose we are establishing y and x. So, there should be theoretical support or you know logically support you know that you know this you know x is the a influence of y, otherwise you know there is a high chances that you know why can because of you know x or there may be some other variables, which can also influence the y.

So, at a particular point of time your theory will justify that you know yes this particular you know structure is a you know very useful or very relevant for the empirical you know investigation process. And then second requirement is the optimum number of decision variables so; that means, a regression modelling is the game of dependent variable and independent variable, and the minimum requirement is you one dependent variable with the one independent variable, but over the times keeping dependent variable constant independent variable can increase and in the later case a independent variable can increase and independent variable can also increase.

But you know the simple structure of econometric modelling will be a o you know this is a dependent variable case and this is a independent variable case, this is a one and you can is you one variables and this is called as a many variables or it is a you can say that you know one and one. So, this is a simple one to one if not then this is the one to many is the a more complex kind of you know things and another case is you think what called as you know many many.

So, this is this is called as you know bivariate structure, this is called as a multiple structure and this is called as a multivariate structure and a so, what is happening actually one in the one to one case. So, there is you know question of optimality, but in the case of you know one to many or many to many. So, we need actually optimal in numbers.

So, how much optimal numbers with respect to independent variables where in dealing with you know one many; that means, one dependent variable with the multiple independent variables the multiple independent variables may be 2 in number may be 3 in number may be 13 numbers. So, if you actually it is not optimum and correctly

specified then the question a may be lead to you know over fitting and a you know question of you know under fitting right.

So that means, if the more number of variables requirement and they you a introduce less number of variables, then it will go for you know under fitting structure. And a if you if you are requirement is a 3 variables and unnecessarily you are using 30 variables, then it is question of you know over fitting models. But we need a structure which you called as you know optimal structure, where you know the models are you know exactly fitting. So that means, there is a optimum number of variables which can address these engineering problem more effectively, and that is you also case in you know in the that is the case in the case of you know third models that is called as you know many many where multiple in dependent variable and multiple independent variable.

And then you have a some kind of you know basic requirements and that is what you know called as you know classification of dependent variable and a independent variable and ultimate while doing the kind of you know structuring restructuring the kind of you know empirical testings. So, one of the basic further basic requirement is the a sample size. So, when we add one after another variable into the system, then here sample size should be start increasing a you know corresponding to increase up you know variables, otherwise you what is happening.

So, if your sample size is not large enough depending upon the number of variables then the model validation will be largely effected. For instance every time your sample size should be substantially high than the a number of variables, but if the case is other way around then regression modeling, we will completely fail. So, this is one of the very very fundamental requirement and understanding value for any kind of you know engineering econometrics.

then the concept called as you know data structuring, and in the data structuring a sometimes we need data transformation sometimes we you need actually a you know some kind of you know integrations or some time kind of you know structuring with respect to plus external times region penal. So, whatever ways you can you know do the structuring. So, ultimately the data structure will help you to estimate the model and the estimated model will give you the better results as per the particular requirement. Then the data visualization which you have already discussed because it will give you the

indication about the appropriate functional for which is very much required for the a regression modeling, otherwise it will be give a again bias results as per the a particular investigation process is concerned.

Then choice of techniques in fact, to we have a couple of techniques with through which you can you know address the problem. So, some of the techniques you have to why. So, like you know there is a parametric techniques, non parametric techniques ok. So, we have to you know be careful about this, but ultimately for engineering econometrics most of the instances, we will use parametric technique.

So, here the choice of techniques a maybe depends upon you know what kind of you know approach you have to apply like you, what we have already discussed like you know OLS technique or GLS technique or (Refer Time: 28:20) techniques something like that, then picking up the right models because we in the process of investigations you may have a different functional form, different kind of you know modelling structure.

Even if you linear in your fixing the linear model, still you may have a different models with respect to variables involvement 2 variables, 3 variables, 4 where one after another variables, you will define the different models estimated models or together at a different point of time. And all we will give you different kind of you know interpretation and the kind of you know the kind of you know engineering requirement. So, you must be very careful how many flexibility you have in the system and then ultimately which one you have to pick up as per your you know best requirement.

Ultimately you have to pick away best model, which can address your engineering problem more effectively and as per your know objective requirement or you know engineering requirement and finally, you will go for you know model validations. So, what I have already mentioning the previous slide model validation on and model you know the kind of you know robustness checks or sensitivity issues. So, there are all you know extra kind of you know pitching which you can do or you know extra flexibility we are you know allowing in the empirical process, to have you know better result as per the particular you know investigations you requirement.

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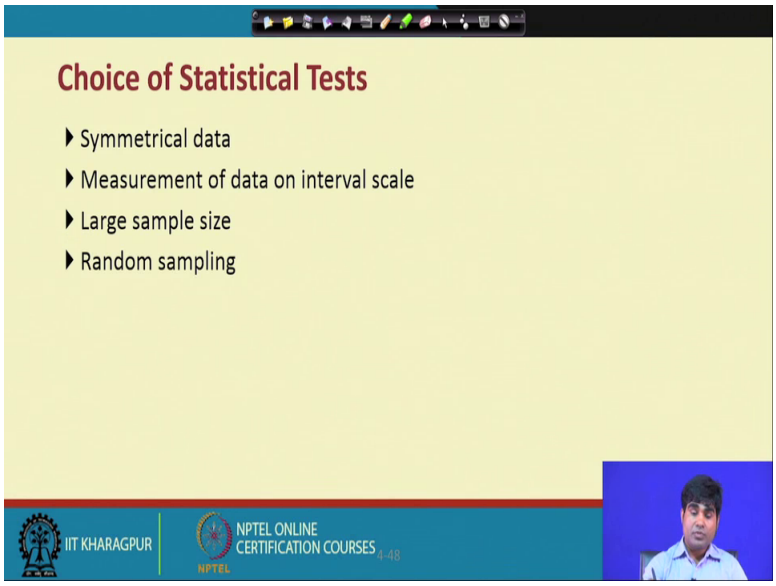

So, for a choice of a statistical tests are concerned. So, must of the times we are using parametric structure, but in that case there is a standard requirements data must be symmetrical in natures, where you know where there are many ways you can check the a symmetrical feature of the data. One of the simple instances find out the descriptive statistics and if you if you find the mean media and mode are you know coincide, then you can actually say that you know it is a kind of you know symmetrical structures. We have a descriptive econometrics will discuss in details about these issue and then measurement of that on a interval scales.

So, we have a residual scale we have a you know categorical structure, but interval structure is one of the best way by the analyzing the a kind of you know problems engineering problems by the help of you know any kind of you know engineering econometrics. And we need a every time to large sample size, ultimately large sample size is a kind of you know you know digital work what is the sample size that is a you know better depend you know depending upon the variables involvement, but every times you try to have you know large sample size.

Of course, in the case of you know time series modelling that may not be very issue because time series data usually is a having you know very big data, what we try to find out you know optimal data structure through which your model will be better feet and you know as for the particular you know object requirement.

Then we must of the instances follow the random sampling mechanisms because sampling is a very big component and a different labels of samplings are there and different types of samplings are there, but in the process of empirical investigations, random sampling approaches most better approach and most of the instances we frequently use random sampling approach while addressing the a engineering problems in a kind of you know point quantitative structures right.

So, in the later stage, I will give you the details about the sampling, but in any case. So, random sampling approach is a most effective approach and many instances 99 percent cases of this engineering econometrics we use random sampling approach.

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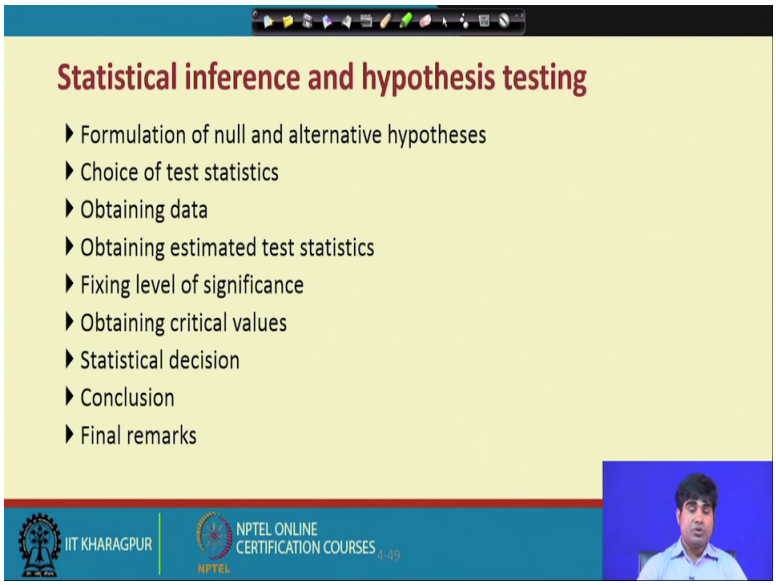

And then we will go for you know statistical inference and hypothesis testing's and in the case of you know regression modelling. So, what all though we have already highlighted the various steps, but. So, far is a technical part is concerned, the process will start with you know the formulation of null hypothesis and alternative hypothesis, then it will be it will start with you know or start with you know picking of the choice of statistics ultimately when you are setting all and alternative hypothesis our target is to reject the null hypothesis.

And for that we have to find out a test statistics having the data and a most of you know estimated test statistics, then what will do you know fix the level of significance and then obtain the critical value and then you go for you know statistical decision.

So that means, the estimated test statistic and the critical value and then the decision will be the if the estimated value will be over take the critical value at a particular probability level of significance then you may be in a position to reject the true null hypothesis, which is our actually requirement or that the requirement of you know regression modeling.

And the statistical decision in fact, is the crucial and where is it will give you the clue that you know whether you reject the hypothesis or you know accept the hypothesis, then on the basis of that you can actually conclude and come with a kind of you know remarks and you know commands to address this particular you know engineering problem.

And over the times we will discuss in details how will go by step by process, because most of the problems will be analyze in this angle only. So, this steps are you know frequently use in the subsequent stages there is there should not be any issues and you should not have any kind of you know misunderstanding about the steps and the kind of you know requirements while addressing a particular you know business problem as per the particular you know requirement.

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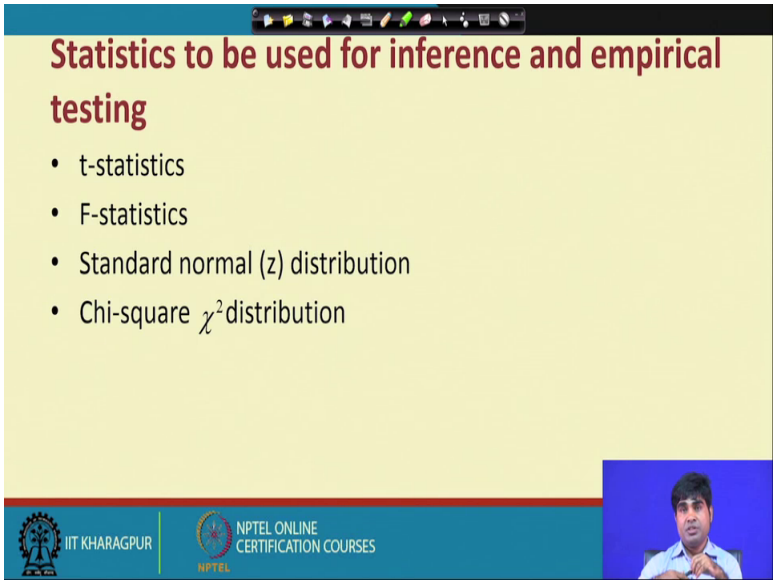

And separate test statistics are concerned. So, frequently used a statistic in the econometric world is a t statistic F statistic a z statistics and chi squares, but so for as a engineering econometrics is concerned. So, we frequently use t and F statistics and for

regression modelling a specifically we use the static to related the variables independent variables. In fact, on the dependent variable and we use f statistic to examine the overall fitness of the model regression model and the kind of you know degree of you know associations.

So; that means, in the engineering econometrics the most frequently used a statistics in the empirical processing is the t and F statistics. Of course, some of the instances we use actually chi square test and z test depending upon the particular you know requirement, but knowing your using t statistic and F statistics some of you know mandatory requirement of the regression modelling to address the engineering problem and the kind of you know particular you know requirement. And so, in the process of you know investigation. So, we are actually setting the null hypothesis and alternative hypothesis. So, the idea is you know rejecting the true null hypothesis or accepting the false null hypothesis.

So, the structure of testing is like that you know a question of you know type 1 error and type 2 error. So, rejecting true null hypothesis the question of you know type 1 error and accepting the false nulls hypothesis is the question of you know type 2 error.

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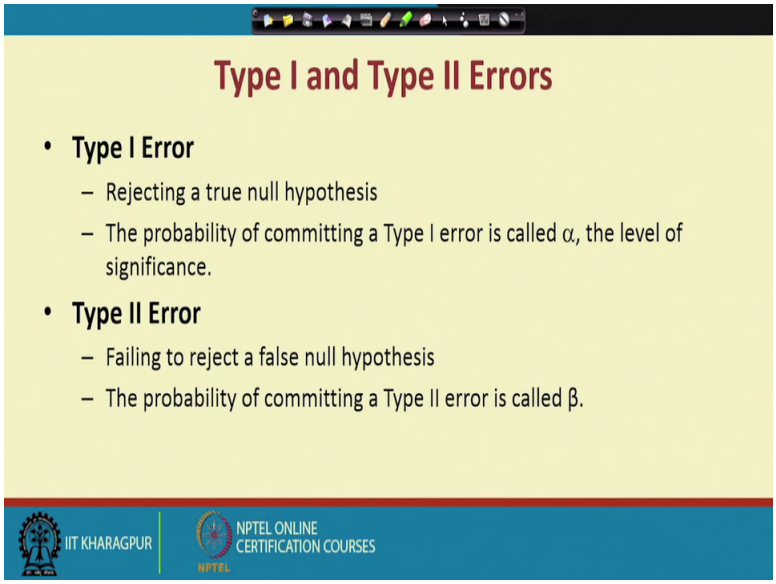

And the type 1 error represented by alpha and you can indication that is the probability level of significance, and type 2 error is the indication of you know beta. So, ultimately so, this is actually 100 percent and you start with the type 1 error. So, type 2 error

ultimately it is a testing procedures to check whether to accept the null hypothesis you have to reject the null hypothesis.

And these are all standards for any statistics or you know any kind of you know econometrics, but you have to know. So, the procedure is you know setting the null and alternative hypothesis then it is you try to you now check the a percentage of you know type 1 error so; that means, what should be the percentage while you know checking rejecting the true null hypothesis or you know accepting the defaults null hypothesis.

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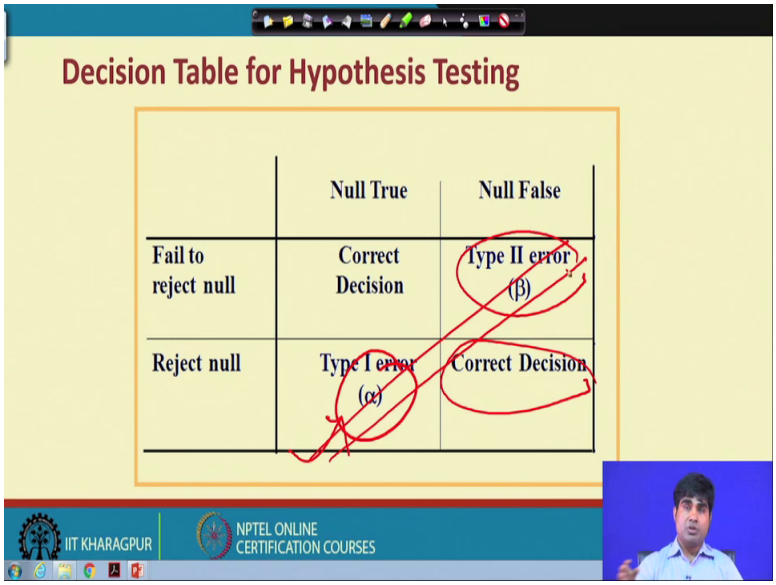

And these structure is like this and so, the if you know fail to reject the null hypothesis in that true null hypothesis case this is called as you know correct decision, otherwise a otherwise it will it if you reject the true null hypothesis, then this is called as you know type 1 error that is called as you know probability level of significance and most of the in terms is you follow this way, because this is a more simpler and define a representation. And fail to reject the personal hypothesis is called as you know type 2 errors and if you reject the false null hypothesis, then it is called as you know correct decision so; that means, we follow the particular you know diagonal online. So, alpha labels or you know beta labels.

So, this is how the a decision making process is all about in the econometrics or you know statistics.

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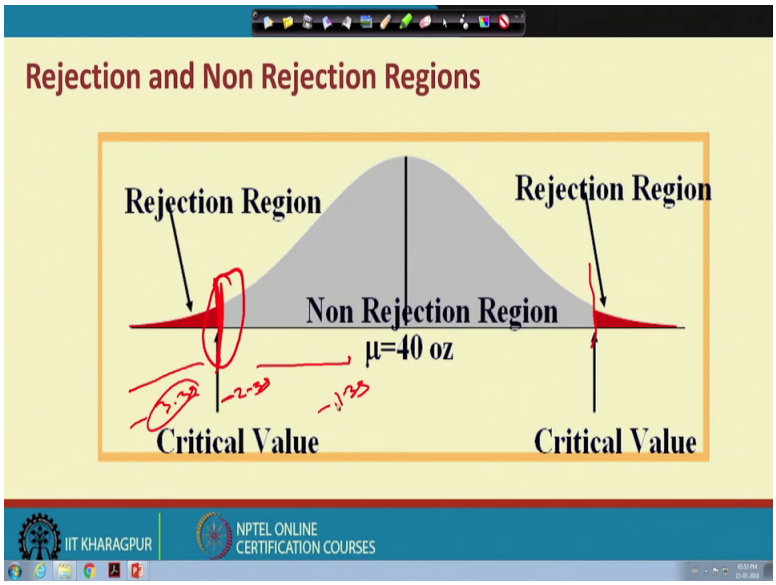

So, likewise we have to follow the procedure and you know a coming with your kind of you know decision. So, usually you know you know graphically a we have to follow the particular you know normal distribution structure to address the problem and here. So, with the decision making process is you know the game between a critical value and the calculated value and that to with the level of you know probability level or significance. So, the that is you know alpha fixation; on the basis of alpha fixations it will give you the indication about the critical value and. So, critical value is the benchmark.

So, we have 1 tail test and 2 tail test 1 tail test you know depending upon you know alpha and again 2 tail test depending upon the alpha for instance 5 percent, if it is you 1 tail then it will be 1 side it is 2 tail them will deserves divide 2 and allow both the sides. So, now, here on the basis of you know alpha you have to find out critical value, which depends upon you know t tables and F tables or chi square tables then on the basis of you know data and you know test statistic formula. So, we have to process the data and calculate the test statistics and the decision making process will be like this. So, this is a critical value, we have to see the position of the a test statics, a calculate test static whether to come with a rejected zone or you know accepted zone.

So, now this is a minus let us say this is a minus 2.35. Now the calculator static is a coming let us say minus 3.35 so; that means, it is coming actually at a rejected zone so; that means, here we have to reject the true null hypothesis. If it is less than that ah; that

means, instead of minus 3.35 we have to say minus 1.35, then we have to accept the null hypothesis. So, in that case you are not in a position to the e z the true null hypothesis. So, this is this standard format and ultimately when you will work for a research problem with a big data big data or something more complex problem software will help you to get the results and a you need not required to show the diagrams automatically you like to know what is the probability labels, where the a the particular hypothesis will be rejected or not rejected right.

So, one way is to fix the probability and check, whether you can reject the tool null hypothesis or else you know you have to change the probability labels and every labels you have to check whether you are in a position to reject the it null hypothesis. Technically a we like to fix always you know 3 labels of in alpha 1 percent 5 percent and 10 percent. Alpha 1 percent 1 tail it can be also 2 tail similarly alpha 5 percent 1 tail or 2 tail and alpha 10 percent 1 tail and 2 tails so; that means, technically you have actually 6 possibilities. So, you have a 6 different label. So, in a critical values then you check with you know test statistic with a critical values at what point you have to reject the true null hypothesis.

So, here the idea is that you know every times your target or you know approach should how to reject the true null hypothesis, then you can actually validity or you know hypothesis and the kind of you know objective which you like to investigate. So, here approach is not just to work out something. So, here approach should be in such a way that you know you is somehow you have to in a position to reject the true null hypothesis; that is how in the first instance if it is not coming. So, you can increase the sample size, you can you know change the functional form, you know you know include more number of variables exclude more number of means a couple of variables.

Ultimately you find out a particular you know estimated models, where you know you are in a position to test or you know reject the kind of you know high null hypothesis in such a way that you know you are established the problem more effectively and come with a kind of you know insides, which can address here you know engineering problem in a much better way.

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So, ultimately so, then why we need actually econometrics which we have already discuss, and this is actually in the need of econometrics is you know empirically testing or verifying the existing theory and with the intention that you know is there is the new insides to the existing theory, because over the times there are lots of dynamics happenings.

So, the existing theory may not work and whether you know the idea is very simple whether the existing theory is still valid. So, the comment will be depending upon the a outcome of the engineering econometrics and if there is a need of you know change in what extent we can change, that is how the new insides will help you to modify the theory that is the engineering theory as per your you know particular you know requirement.

It is completely experimental process, where we are here idea is just to see whether we can get some kind of you know new insides to the particular you know engineering problem.

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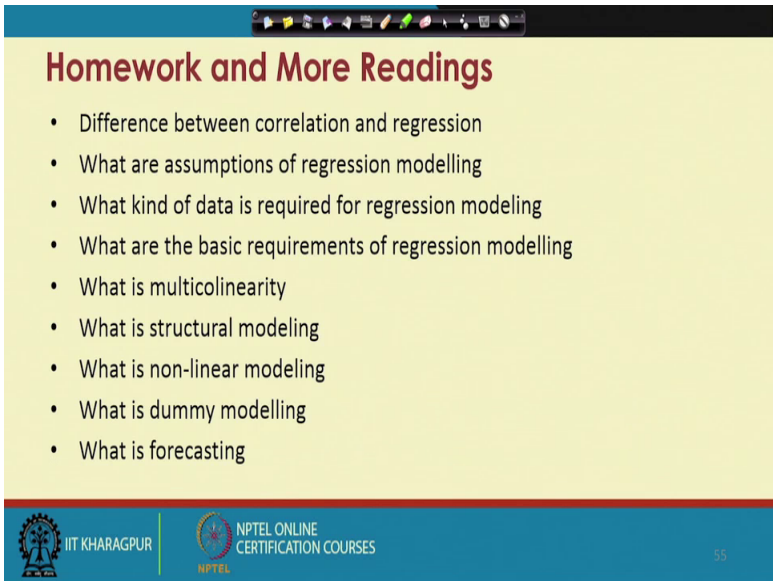

And with this you know I just and with this some of some of the some work for you. So, you know you should you know now the difference between the correlation and a regressions, what are the assumption behind the regression modeling, what kind of you know data is required for regression modelling then what are the basic requirements of you know regression modeling, what is a kind of you know multicolinearity problem, what is structural modeling, what is a non-linear modeling, what is dummy modelling and what is all about you know forecasting.

So, there are couple of you know homework's you can do, but for this particular you know lectures. So, these are the items which you can actually just to explore and get to know and acquainted as per the particular you know requirement; with this we will stop here.

Thank you very much have a nice day.