Engineering Econometrics
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Lecture – 09
Exploring Data on Spreadsheets (Contd.)

Hello everybody, this is Rudra Pradhan here. Welcome to Engineering Econometrics. And in this lectures, we will go for data visualization and the in the last couple of lectures, we have already discussed something related to excel use, excel operations and some of the beauty of the excel spreadsheet, how to perform all these you know you know kind of you know understanding of the data at a the kind of you know function use and as per the requirement of data analysis, engineering analysis and engineering econometrics analysis.

But here, in this lecture typically, we will go for some kind of you know visualization. So, that means, getting some insights from the data is one part of the game and then understanding the data for the modeling requirement, you need some kind of you know processing and that too for that we need a data visualization. For instance, with the help of a particular you know spreadsheet or you know a data for a particular you know distant variable or more number of decision variables, and you need to know the relationship among these variables. One of the particular requirement is the building a functional relationships and what kind of you know functionality you have to build and what kind of you know model you have to choose whether it is a linear one, non-linear one, again within a kind of you know non-linearity, you may have you know inverse functions, you may have you know exponential functions.

So, your modeling can be anything. So, until unless you understand the data as per the problem requirement, so you cannot just pick up a particular model and fit the model and go for the empirical investigation, empirical estimation process. So, that is why you have to strengthen our you know requirement to strengthen our structures. So, it should go step by steps understanding the data, data structuring, data manipulations, data transformations and data visualizations.

So, these are all step by step process before we go for a you know using you know hardcore econometric modeling and then as per the particular you know engineering

requirement. So, let us see how is the data visualization process and what are the ways you can actually understand the data more accurately and you can visualize the data you know more accurately and as per the particular you know requirement. So, for this we need to know the particular you know structure.

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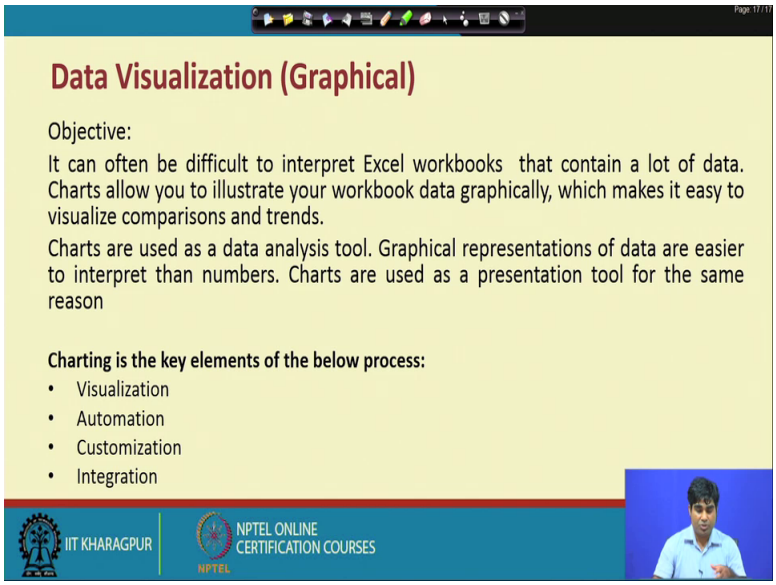

So, basically, data visualization sometimes you know you know in a kind of you know structure where you need to know the a shape of the particular you know series or the shape of the particular you know data means the kind of you know a variables, behavior over the time and over the kind of you know cross sectional unit. So, that means, earlier we have discussed that you know data can be reported for a distant variable or either in the form of you know a cross sectional unit and that to called as you know cross sectional data and it can be reported in the form of you know time series for a kind of you know cross sectional unit, then that is called as you know time series data.

So, now for a particular a you know, let us assume that there is a example of you know financial problem or something kind of an engineering problems, where you know for a particular year what is the behavior of you know companies productions a you know with respect to a 5 different companies or you know 50 different companies. So, keeping your constant and then you are plotting companies you know production, behaviors, you know means say in a kind of you know competitive environment.

So, that means, the basic idea here is you know for a particular year, how the companies are you know behaving with respect to productions which companies a high production, which companies you have been low production, which one is the, what should be the average of you know whatever companies are there in this particular you know spreadsheet, so, like that.

So, now, understanding all these things, so you need actually a excel use and again you just you know go for plotting and then plotting can give some kind of you know insights instead of you know who put asking the excel to find out which one is the maximum, which one is the minimum, what is the average. So, if you plot, then by default, you can know what is the maximum and what is the minimum and how is the behavior of you know all companies within the maximum and minimum.

So, that means, it will give you a accurate picture of the data as per the particular you know engineering problems requirement. Similarly, in the case of you know time series data, so here, so you keep you know particular cross sectional unit constant, let us say TATA is a company which is constant and you like to know TATA company is a total productions over you know a last 10 years or you know 30 years, you just plot and then you can you can get to know which particular is the year is the highest production, which particular year is the lowest production, what is the average production over the last 10 years.

So, this gives you know some kind of you know clarity before you go for some kind of you know modeling and it itself give you the kind of you know insights that you know whether your data is the I means, data is the kind of you know structure where we need actually some kind of you know analysis and that to we experts some kind of you know new insights. What I have mentioned earlier if all the data are you know same, then visualization by default will give you some kind of you know indication; that you know a for a every units, whether it is a time series unit or cross sectional unit, it will be a kind of you know straight line only.

So, now if there is a there is you know ups and downs; that means, there is a volatile volatility and variation of the data. So, that is the, that is the signal through which you can proceed for the econometric modeling. So, that means, the minimum requirement of econometry modeling is that you know data for a particular decision variable or all the

decision variable should have some kind of you know volatility. In technical, or in econometrics term the variation of the variables or variation of the data should not be equal to 0.

So, that means, if the standard deviation of a particular you know series is coming 0 ; so, then you may not actually use that use this data for the kind of you know predictions or something like that. And there are many instances you know why the variation of this you know data will be equal to 0. So, one way just justification if the against all cross sectional units for a time series and again a product cross sectional, for a all time series if you find the informations are same, by default standard deviation equal to 0.

So, in that context that is not useful for the econometrics analysis and the kind of you know a engineering a requirement. So, you must be very aware about all these things before you go for you know analysis and here, in the data visualization, so the objective is just to know the structure of the data and it can give you some kind of you know clue about the functionality and what we can do the in this particular lecture, so to know visualization, automation, customizations integration. So, these are all things can be available and that too basically here, visualization process in the help of you know, graphs and charts.

So, graphs and charts give you some kind of you know a better clarity compared to quantitative data you know because quantitative data will give you one time results. It cannot give you a A to you know a Z visualization or you know clarity well, that is a graphical inspection is somehow mandatory against as per the requirement of the you know advanced data analysis and the kind of you know engineering econometrics requirement.

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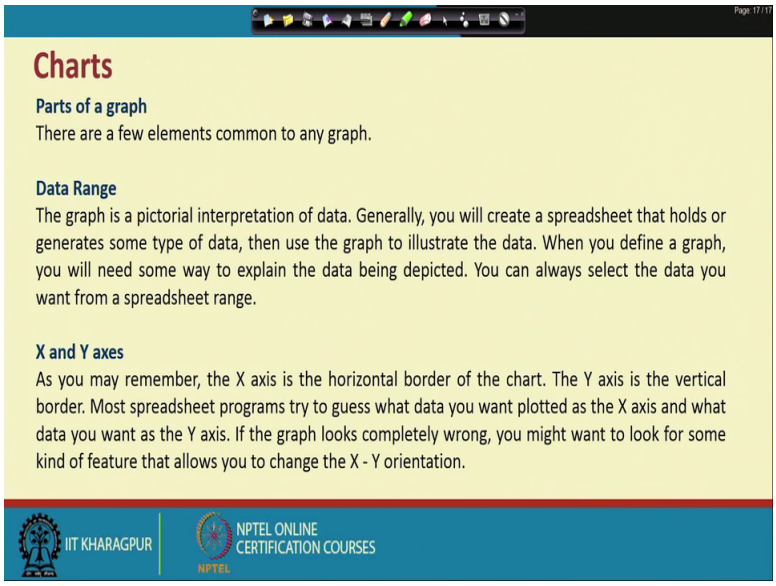

So, now, there are many things are there. So, starting with you know charts this part of the graph and then data range, you know axis x x and y depending upon you know kind of you know protein. So, we have actually 2 dimensional kind of you know integration or you know 3 dimensional integration something like that. But usually, what we can do, you can go to visualize a particular you know a dataset for a particular variable and then you can apply for a all other variables and simultaneously, jointly, can you know predict in a three dimensional pictures or something you know more attractive you know charts through which you can be you know visualize the data more accurately, understand the data more accurately as per the engineering econometrics requirement or engineering problems requirement.

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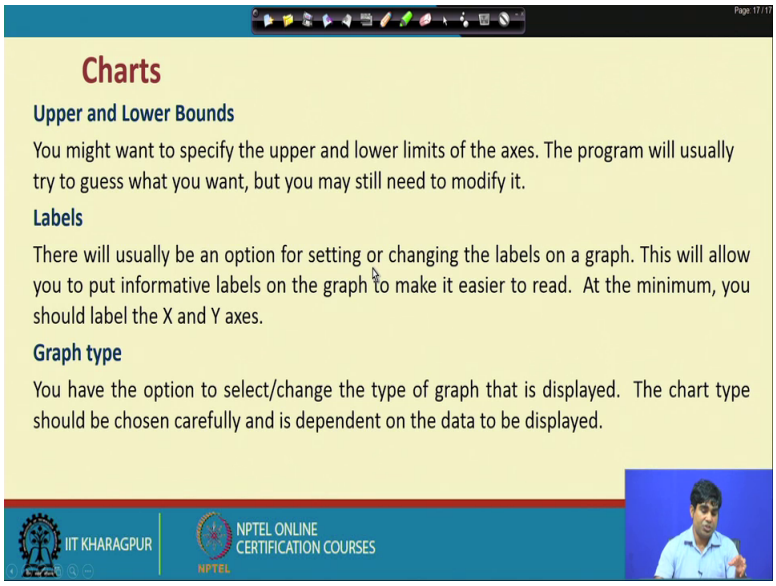

So, there is a upper law, upper bounds lower one, that is a what we have already discussed in the form of you know quantification by maximum of the series a minimum in the series. So, graph types you know various.

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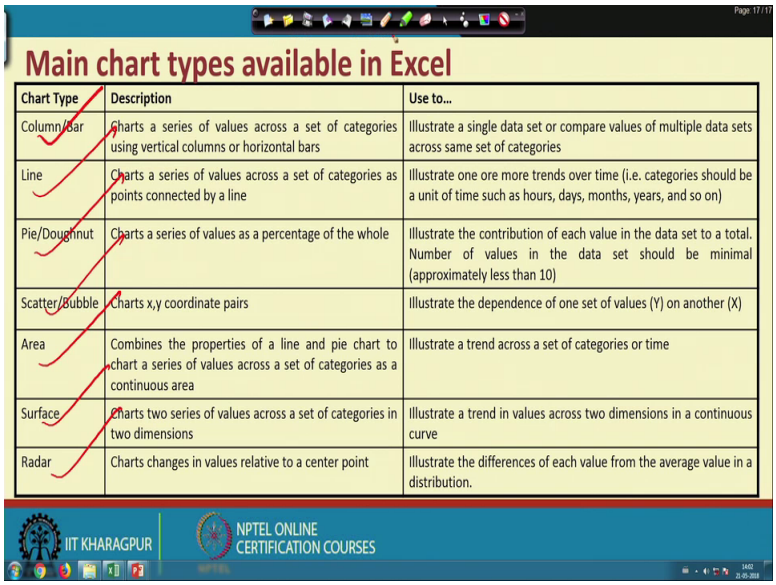

So, this is actually snapshot of you know a graphical inspections and that too data visualization through some graphs and charts and we it is not a single kind of you know structure like you know when you go for some kind of you know quantifications. Suppose, you need to know the you know series a summary, you can go for mean

statistic of the series, median statistic of the series, then mod statistic of the series variation a range, maximum, minimum.

So, many items are there to give some kind of you know quantifications about the data for that particular you know variable or the series of variables for a particular you know engineering problem. So, likewise, in the data visualization in the graphical part ok, so this is a graphical structure all togethers we are really we will get you know clear cut visualizations and some kind of you know, you can say called that you know it is a kind of you know image through which you can inspect you know in a better way and to way you know analyze better way or to give, I mean see to give some kind of you know remarks in a better way after seeing you know in details. And you using a quantifications, you know with your single statistic cannot give better insights about the particular you know structure but graphical plotting we will give you some kind of you know beauty better on that aspect.

Even if you know after you know using any kind of you know econometrics say a modeling, so, you have the estimates estimate means have a econometrics inputs econometric output; that means, technically estimated output and with the help of estimated output, so, you can go for a also you know prediction and forecasting and in a you can have a quantitative informations and you can have also visualization. You can also do the plotting, that is you know forecasting plot structure you know. It can give you the clue that you know how the a kind of you know a shape of the particular you know a distribution of the series you know with a given samples or given data, the actual behavior and the predicted behavior and what should be the behavior you know a as per your you know forecasting.

So, that means, it will give you clarity or you know clear cut pictures as per the particular requirement. We will discussed in details in the later stages how this you know visualization can be possible with respect to actual data and the forecasted data and the kind of you know insights or the kind of you know requirement. By the way, so these are the various you know charts. So, this is a column a column, but you know line chart, a pie chart, scatter diagrams, area under the curve, surface, radar, type of you know diagrams.

So, that means, you have a different kind of you know, you know process all together. So, that means, what I can say that you know visualization is in a in a kind of you know multiple or you know multi layers. So, we have a same data you can visualize in different angles all together. So, that means, you are you know doing the inspections in different levels all together. So, then, it is a one way you can called as you know something called as you know robustness check right.

So, if you are plotting with you know let us say lined a line in graph or something like that in same visualization, we do doing through some kind of you know scatter diagram or something like that. Then, you will find you know if the observation, whatever observation you are finding here; the same similar kind of an observation you are also finding other graphs. Then you know the confidence levels are the kind of you know a strength of the particular you know understanding and strength of that particular analysis should be much better actually.

So, that is why, again my suggestion is that you know do not use a single statistic to analyze certain you know problem and do not go for you know a single or you know kind of you know instrument through which you do the visualization. So, every times, you must have some kind of you know alternative or flexibility to do the continuous visualization by different a approaches or you know different kind of you know chart types and then see the accuracy of the particular you know data and the kind of you know signal of the data before you go for you know hardcore and data analysis or some kind of you know econometric modeling.

So, that means, technically it is not. So, you know easy that you know just you do the kind of you know structure and you know go for the kind of you know analysis, but it is you know you know it is a kind of you know a very extensive kind of you know spreadsheet a means, the use of you know spreadsheet and you have a plenty of you know options and it is up to you how depth or a how much understanding you have in this you know you know the to know the use of you know spreadsheet or the use of you know excel.

And, this itself is you know big sub pairs and where every concept you know partitions are there. So, as per your requirement, you can just you know give the command and then look for the kind of you know analysis and the kind of you know insights as per

your you know requirement or you know the objectives of the engineering problem. So, now,, so, there are lots of descriptions are here against column, column and bar.

So, charts and then what we use and then again the line a line type, you have the description charts a series of values across a set of categories as points connected by a line. So, where we have to use similarly pie diagram, scatter diagrams, area diagram, surface diagrams, radar type of you know diagram. So, the possible areas where you can use, but ultimately you enter the data and then, if you go for visualization by default, all these you know items will be coming into the pictures like you know bar diagram, column diagrams, lines, pie, pie charts, area diagram, something coming into the a picture.

So, just to give the command by default you will get some kind of you know visualization and the kind of you know insights then; your job is you know just do the visualizations with you know multiple charts and multiple you know absence. Then you see whether the particular you know observations are very consistent over all the kind of you know visualization process. If it is like that, then you can just proceed accordingly as per the advanced requirement or the particular you know requirement.

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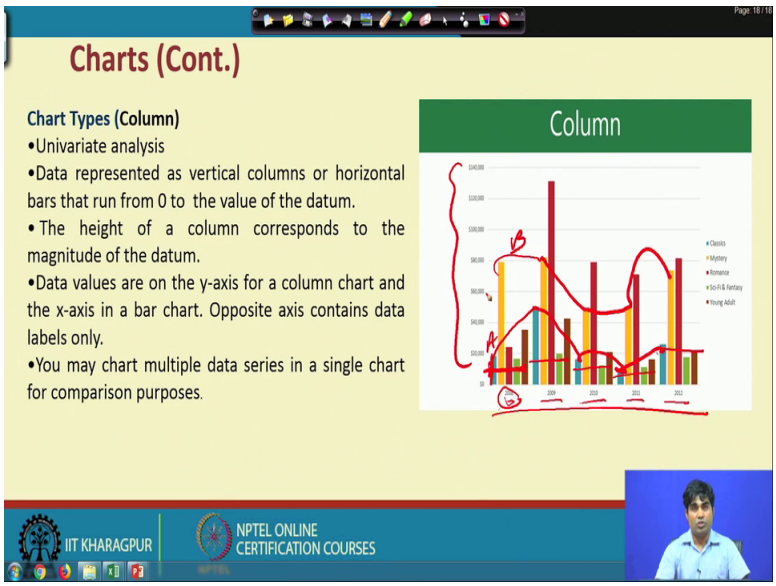

So, now, so, some of the you know snapshot I can highlight heres, let us say, we start with you know chart types column charts. So, he see here is, so, this is a kind of you know ear wise informations. And usually, if you go for you know some kind of you

know a simple chart kind of you know diagram. So, you will see here let us say this is a kind of you know productions items and that too for a particular you know unit with you know different times, see here the beauty of this particular structure. So, it it is consistent with 2008, 2009, 2010, 2011, 2012; that means, it is a consistently you know in a reporting in a kind of you know system. You can know that you know over the years, so, how is the kind of you know movement right.

So, you see here this is a production behavior and 2008. So, you will find different colors all together. So, 1, 2, 3, so, that means, technically; so, this is a 5 numbers. So, every years, so, we are comparing 5 different organizations profit behavior or production behaviors or some kind of you know outcome. Similarly, 2009, how is the kind of you know behavior; 2010, how is the kind of you know behavior; 2011, how is the kind and again 2012, how can how is the kind of you know behavior. It is come in a complete picture all together.

So, now let us assume that you know you like to just compare you know. So, the first ones that is means the kind of you know blue line only. So, you just join the blue lines, then you check the kind of you know trend here is ok. So, this is how the behavior of blue line. Similarly, you like to know what is the behavior of you know your loss. So, this may be the information about a particularly in organization. You just connect actually like this, see here.

So, these are all actually a different a behaviors. So, that means, I am just comparing actually blue with you know yellow, then I find the organized, let us say, this is your company B and this is a company A. So, the simple you know visualization now or simple insights here over the years you know organization B is much higher than you know A.

So, likewise, you can you know compare company to company organization to organization and this is what called as you know time stitch plotting with different organization. Similarly, you keep you know year constant and then you can actually we visualize again company behaviors or else what you can do. So, you put a particular company, then year wise variation you can also see. So, a many instances or many different ways actually you can do the kind of you know processing and that itself is a beauty of this you know data visualization process.

So, ultimately this is a kind of you know a process through which you can visualize the data more accurately with the you see here. Now, in a one particular you know means in a kind of you know small umbrella, you are visualizing phi you know 5 different companies with you know 5 different years all together. And now, if you just put the data in excels and do not go for the visualization, then the accuracy accurate results or accurate kind of you know inference or the kind of you know remarks you cannot observes simultaneously.

So, this, so,, so, here you can just imagine the beauty of the data visualization. So, that means, in one stroke, you can get all kind of you know informations, year wise, company wise and something like that you know all kinds of you know informations in one basket. Similarly, this is your kind of you know a line kind lined you know charts.

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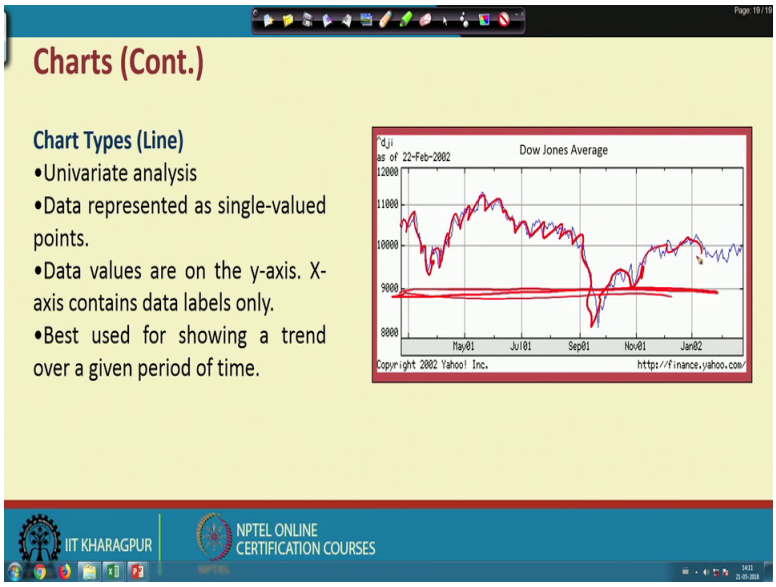

So, like that what I have mentioned that you know you just join the yellow bars and midpoints of the yellow bars, you will get a cord. Similarly, you can join the midpoints of all the you know blue bars or green bars; you will find there you know lines. So, just you know take this line here, you will find the behaviors. So, this is a particular company and here is monthly observations are there you see here.

So, these are all kind of you know observation. If these are all different points of you know times. So, you will find a you will find there is a different observations all togethers right. So, that means, from this you can get to know that you know. So, these

data are not uniforms. So, if the data are uniform over the time, so; that means, every month over the years it is same. So, then this will be only all the data will be like this only but here what is happening the data is actually moving like this. So, there is a variations actually.

So, now a econometrics requirement first hand requirement is data should be like this ok. So, then your data is having you know variations for a decision variable. So, that means, there is there is something wrong and the idea behind these engineering econometrics is that you know what is wrong about that. So, our observation or our objective is to find out that you know the kind of you know inference or the that kind of you know factors or that kind of you know causality through which you can understand the variations.

So, understanding the volatility part is one of the prime objectives of you know engineering econometrics and that is how if the information for a particular variable is uniform, so, we cannot use the engineering econometrics there. So, we will be using engineering econometrics where the where there is a variation in the data for a particular you know decision variable and that is the mandatory requirement and the that is the most for the engineering econometrics and then on the basis of that, we like to find out why this variation is happening.

So, there are, there are two other side objectives behind this particular you know issue; first issue is a we try to you know find out the factors behind this variations or volatility and then how should be the actual behavior or the kind of energy desired behaviors and how is the you know future kind of you know trend and the kind of you know future requirement. And these are the basic insights or basic observations we have to explore or you have to find out by using engineering econometrics.

But you know, for a single variable or you know the is spreadsheet like this, it is very easy that you know by looking this diagram and if you say that you know this is what the objective of engineering econometrics, it is like you know, it is very you know nobody can say that this is a this area is a very complex or something like that. But to anyway, they have actually multiple variables and a big data and lots of complexity, that time it is not so easy to do the accurate predictions and do the accurate forecasting. A sometimes, you know it is very contradictory kind of you know situation and it is not so easy actually very plotting one variable and predicting that particular variable for the future

requirement may be very easy, very you know you know means smooth way you can do the particular you know analysis.

But if there are if the situation is like that there are so many variables and they integrate each others, maybe some will be a, some will be pull your you know kind of you know decision variables, some try to push your you know decision variables. In that case, so how you have to do the adjustment, how do these kind of an optimization and then finally, it will do the prediction as per the particular you know engineering requirement. So, in that context, it is not so easy actual. So, you have to be very familiar with the process and understand the particular you know requirement and do the kind of you know analysis.

So, that means, technically, so this is a, this is not actually so easy to do the kind of you know understanding.

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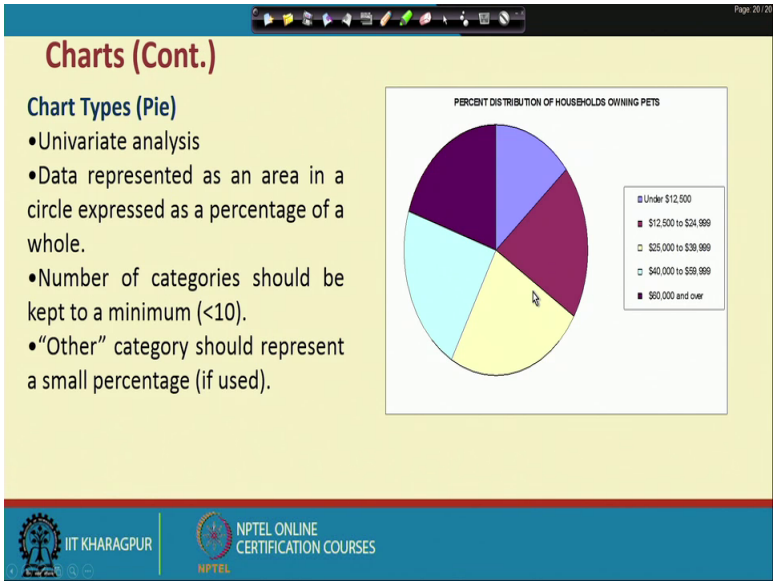

So, you must have a clear cut picture. Similarly, this is another kind of you know visualization process ; the same thing five different companies and then you like to check, you know of course, this particular check itself will give you some kind of an insight which one is high, which one is low or something like that.

So, that means, we have two different environment altogether. Having actually a quantitative statistics and something called as you know let us say qualitative kind of you

know statistic, this is one way called as you know robustness checks. So, we have already quantified to finding out which one is the maximum, which one is the average, what is the average and which one is the minimum something like that. Again, by putting the visualization, you can just compare actually this is what the maximum series for this particular you know problem is science organization and minimum is science organization.

Now, from this plotting, that can be also visualized properly, so, that means, one way you are verifying the effects what we have already observed through the kind of you know quantification or by using quantitative statistics. Again, from the graphical mods you are also checking the robustness and verifying the effects.

So, means ultimately, it has a multiple options. So, and multiple kind of you know scenario through which you are doing the visualization and doing the kind of you know understanding as per the particular you know engineering problem requirement and the need of the engineering econometrics.

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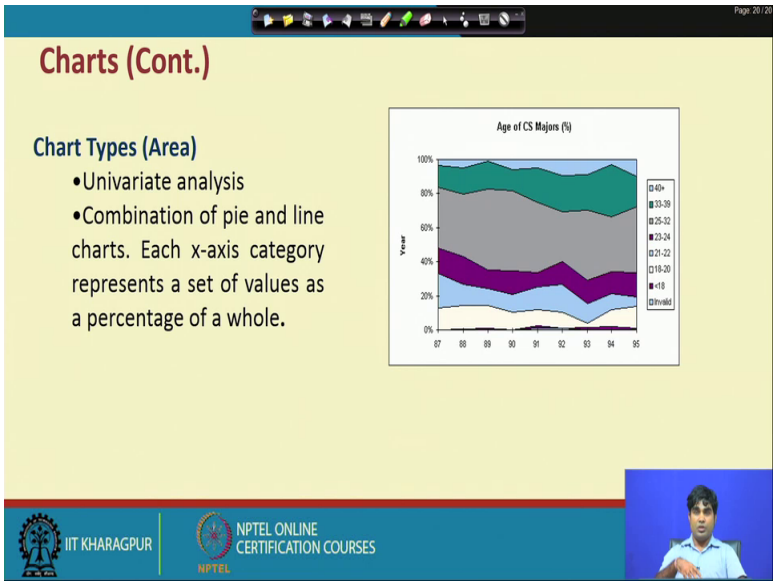

Now, to continue this one, so, this is another way of you know visualization. This called as you know area wise a plotting and same way we will find it now see here. So, the kind of you know gray is actually high one and compared to the brown or something like that. So, that means, the same way you can also visualizing here also again, so means similar

kind of. So, that means, if the visualization is happening here, so, the similar kind of you know visualization will also can a have here.

So, that means, like there is a plenty of you know options like you know if you do the quantitative kind of you know, means you with the quantitative tools to understand the situation, one of the one of the technique may be collage, you know average, you can use mean, you can use median, you can use more than you check the robustness; here also same things. Use different kind of you know visualization tools area diagram, pie diagram, line diagram and then see how is the kind of you know clustering and how is the kind of you know inference whether they are you know consistent and they are you know maintaining the kind of you know similarity or some kind of you know kind of you know errors are there.

So, that means, it would give you some kind of you know clarity or you know some kind of you know strength or to the process of you know analysis and the kind of you know the a process of you know investigation as per the problem requirement or the engineering requirement.

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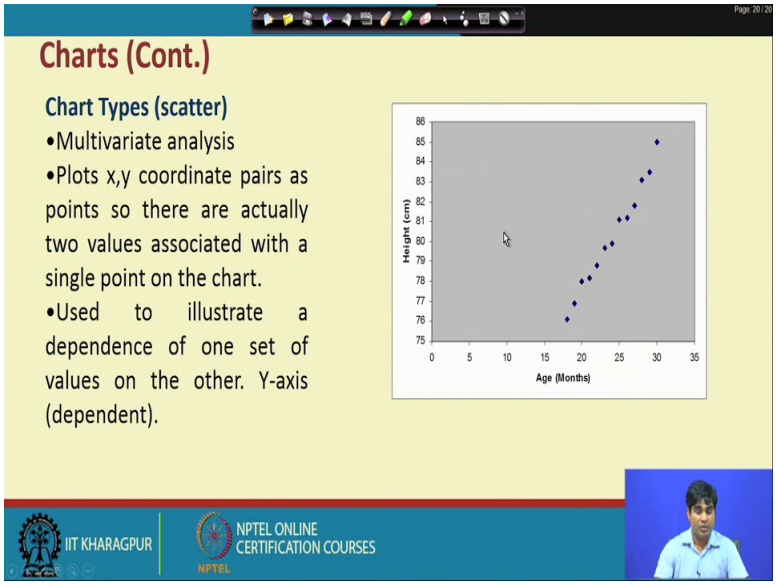

So, now this is again actually kind of you know scatter diagram. So, this is this is very beautiful infact. So, these are all points actually. So, just you join the point then you can get a line and this is another way of you know doing the visualization. So, that means, technically in the engineering econometric problem, there are lots of you know steps you

say whatever steps we have already highlighted that you know problem identification, objective specification, hypothesis in a derivations, then choose up the models, then that collection of data, data analysis something and then you know data estimations, then checking the model, means validations then robustness. So many things are there in the step by step process but at this step itself is again you know very complicated and have lots of you know flexibility. For instance, we are talking about collection data and data analysis. In between, you know there are lots of you know steps in last couple of lectures whatever we are discussing, that is in between data collection and data analysis only.

So, we have not gone to data analysis which is actually a main objectives and main goal of this particular you know subject. But before reaching that point, still we have lots of things you know we have lots of checks or we have lots of you know work homework we are supposed to do before you go for you know hardcore modeling or you know complex modeling to get to expect some kind of you know new insight or something you know new inference as per the a particular objective and the kind of you know engineering requirement.

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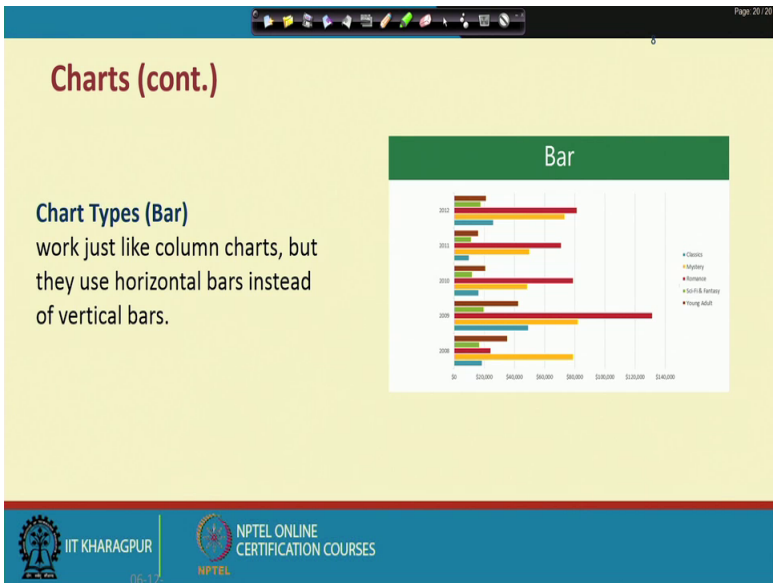

So, now, this is another kind of you know checking. So, earlier it was actually kind of you know you know column, but column you know visualization this is actually row wise visualization; that means, just you know changing the a rotate you do the rotation in fact, you know excel has opera you know kind of you know kind of you know advantage

you can just operate the data in differently. So, that means, you are just you know rotating the kind of you know view different angles altogether; clockwise, anti clockwise ; that means, it is a come what we can say means I am using the language color you know you do torturing the data in a different ways.

So, then by default, you will get some kind of you know insights out of this data and that insight, insight will definitely help you to go for you know further analysis to again to get some kind of you know new insights or you know some kind of you know innovative x insight which is not visualized in the help of you know simple data analysis and the kind of you know simple visualization process but visualization process and simple data analysis can give you some kind of you know you know better kind of you know hint and better kind of you know way to go for you know further analysis where you know you need actually some kind of you know new insight and you know new inference

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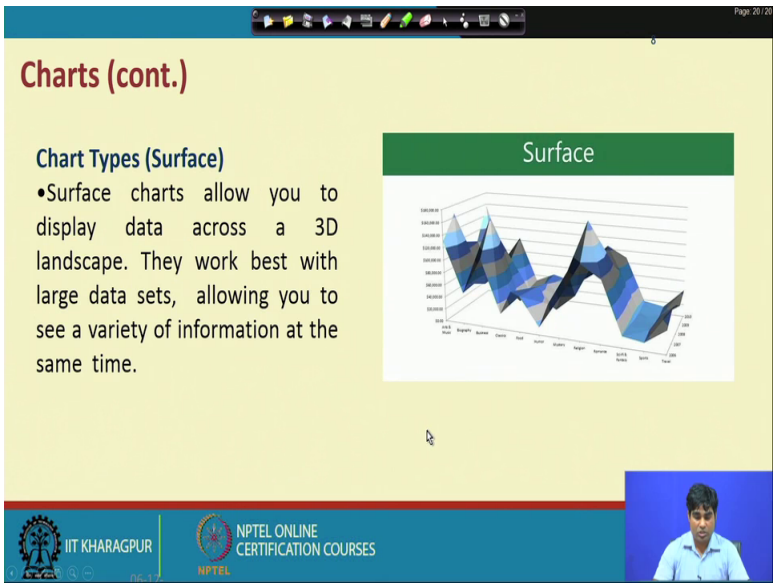

So, this is another way and this is also another kind of you know surfaced diagram which is another way of you know visualization visualizing the things you know. So, that means, so, this particular you know package has a different kind of you know you know structure through which you can you know torture the data differently to get insights out of pt and to analyze the engineering problem.

In fact, in a real life scenario and the kind of you know academic environment, we have different you know visualizations of tires; for instance origin is a kind of you know

software which is very excellent for doing the visualization and that too for the data analysis. So, that means, technically, you have lots of you know quantitative a you know kind of you know softwares we are visualization is not so good, but hardcore quantitative analysis is very good and the vice versa is also true.

Some of the cases, the graphical visualization is very interesting but you know the in depth quantification is not so good; for instant origin is the classic example and there are certain sub tiers which is very handy for both the aspects and cited example is the use of you know excel spreadsheet and then the MATLAB itself. MATLAB is a very extensive softwares and all kinds of you know you know features are there.

So, MATLAB and textures are very broad and x excellent extensive softwares where you know all kind of you know graphical visualization and qant quantif quantitative models are there with you know different angles like what we have already discussed in the case of you know excels like you know we have engineering modules, we have a financial modules, we have a statistical module, we have mathematical module, we have a you know test you know modules you know data mining something like that you know.

So, there you know in the MATLAB is also having you know similar kind of you know all broad features. So, that means, you know these are all you know a very beautiful kind of you know what you can called as you know quantitative infrastructure or you know softwares through which you can analyze the problems more beautifully or in a more attractive way with the intention of you know or with the interest of interest of getting some kind of you know new inference or new insights to analyze the engineering problems as per the sectoral requirement or the kind of you know engineering requirement.

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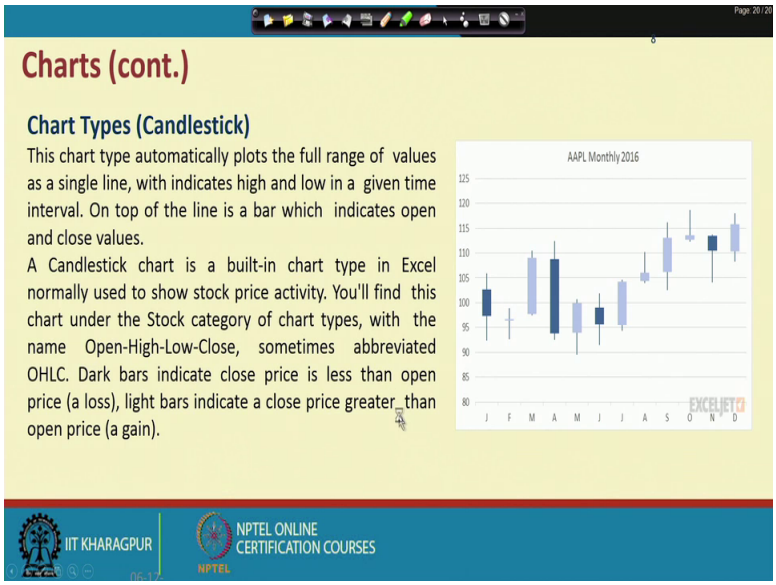

So, likewise, so, there are different kind of you know this is another work of you know visualization process you see here. So, how by itself its say saying that you know, yes, data are you know different and it is not uniform and which one is high which one is low or something like that. So, that means, you know same data you are putting different ways actually, you will getting actua you know different kind of usual togethers.

So, like you know what I mentioned you know look in clockwise, anti clockwise, a downside, upside different angles all together complete pictures what we need actually and one of the fantastic requirement of you know data analysis and that to engineering converter is modeling is that you know you have to visual light and torture the data fast before you go for the advanced modeling.

Until and unless you torture the data and do not understand and do not get any kind of you know better inference about the data and you are not in a position to do better modeling and you know cannot expect you know better kind of you know inference as per the particular you know requirement. So, that is why, you have to torture the data extensively by some kind of you know basic statistics by basic mathematics and the kind of you know data visualization by using different types of you know diagrams graphs and charts right. So, that means, you technically the simple message is that you should be ever about I means all these components.

Until and unless you know all these things you are not in a positions to analyze the problems you know in depth and cannot expect you know you know good results or you know better insights as per the objective requirement and the kind of you know goals.

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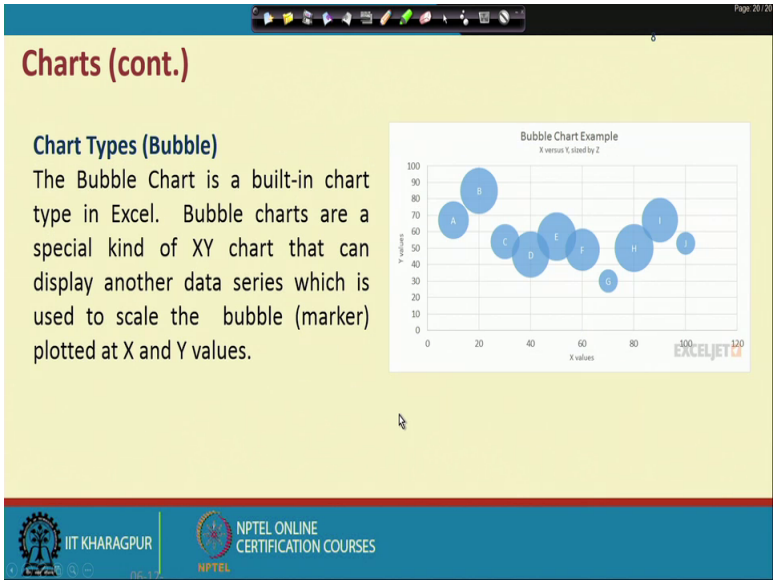

So, you must have you know sufficient knowledge about this. This is again another you know different views or this you know picturing and.

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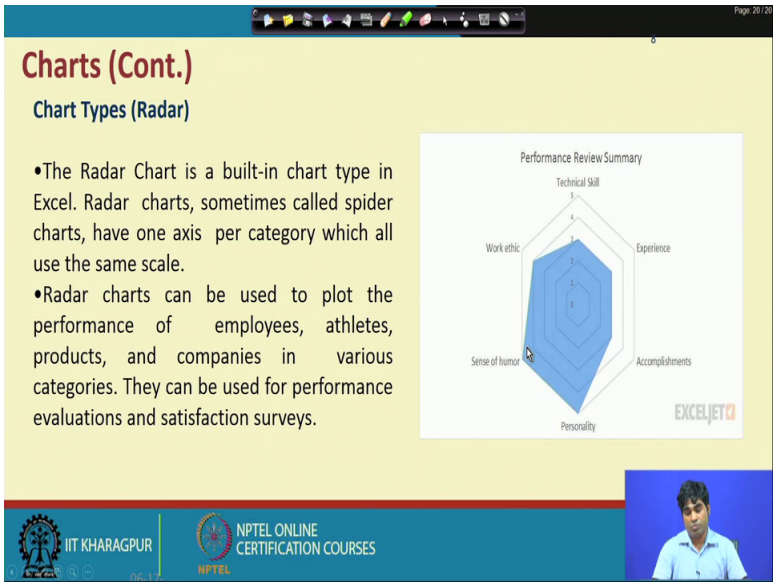

This is also different kind of you know used how to address the particular you know data and then try to explore how is the kind of you know behavior and you know; so, that

means, what do you know we are doing sim simultaneously the robustness check about the data visualization. Of course, you will do this similar kind of you know robustness check in the modeling, but here data a from the data itself that is the first hand input. In fact, for the the analysis of you know engineering problem and the kind of you know econometric modeling

So, here we are doing lots of robustness check before you go for the advanced modeling and these are the process means the first hand process and these are the mandatory requirements, you are supposed to do because otherwise it is a very you know complicated a kind of you know requirement, if you are you know result is not coming as per your you know requirement or you are not getting some kind of you know good insights or you know something kind of you know better insights, then you know the entire things will be you know wastage or the kind of you know not necessary code actually.

So, that is how you must know all these things before you go for you know advanced modeling. So, that means, you know the simple message is that you know if if your input understanding and input process is very excellent, then your output or you know inference insights will be definitely will be excellent and a whether your inputs entry to the models are you know excellent or not that is how we are actually doing all these things; understanding the data, visualizing that data, doing the kind of you know transformation as per the requirement, doing the data structuring as per the requirement.

Ultimately so, these are the various possibilities through which you can expect some kind of you know better results and the kind of you know new insight ah; that means, technically, when we will be acquainted with you know different kind of you know approaches and different kind of you know process, then by default it will give you some kind of you know flexibility against connecting to the robustness check of the modeling.

For instance, in the first hand data you can have a log transport data, you can have a first difference transport data, you can have exponential transpersonal, you can standardize the data and same data you are putting in a different levels all together and that to you are doing through excel operations or you know from the from the excel operation, you get to know all these you know possibilities and all these beauties and against having all these flexibility, so, you can do lots of you know robustness check while you doing the

complex modeling that the first hand data, then you expose check what is the empirical results again use the transport data by different ways, then you check the estimated result. Then you in front of you have a very kind of you know comparative analysis like you know here, you have actually comparing the data at a different point of time.

Now, when you go for you know advanced modeling, that time you use different inputs by different ways of you know transformations and then what you will we are supposed to do during that times. So, you have to compare the results with you know instead of putting time here. So, we will put you know data set 1, this is how the result ; data set 2, this is how the result; data set 3, this is how the results and then you have to pick up which one is the best as for your you know requirement and the kind of you know engineering need.

So, knowing all these details you know, it is not the bad idea. In fact, it will give you the good path for your you know model building and you know torture you know goal to get a new insight and you know better inference as per your you know engineering requirement or the kind of you know engineering need.

So, ultimately, this is your process of you know kind of you know structure through which you can you know do the kind of you know analysis and some of the homework for you for this you know data visualizations.

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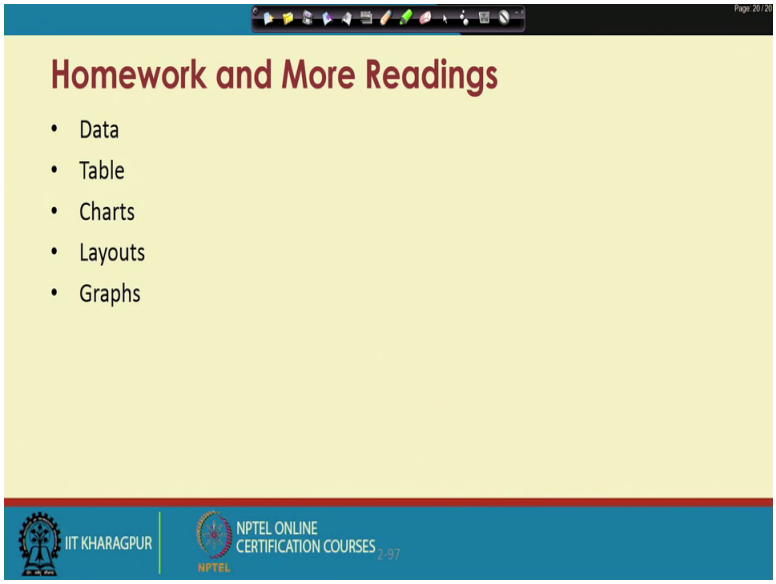

So, simple message is that you know, understand the data for factory, recessional type data, time series data till now not to the kind of you know pooled and pan out because visualization whatever we have discussed here with respect to cross sectional data and time series data.

And of course, every stage when you are checking cross sectional data time series unit will also there, but when you are taking checking time series data cross sectional with unit will be there, but we are not doing any kind of you know pooling here, but you are just checking the first hand informations as per the particular general requirement, understand the tables or understand the charts layouts all kinds of you know graphs and you know be acquainted with the system of you know data how to understand the data, how to get a insights about the data, how to visualize the data. So, these are the things you have to do the homework up to till now and then rest of the things, we will discuss in the next class. With this, we will stop here.

Thank you very much have a nice day.