Quality Control and Improvement with MINITAB
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Lecture - 10
X-bar and S Chart

Hello and welcome to the session 10 on Quality Control and Improvement using MINITAB. I am Professor Indrajit Mukherjee from Shailesh J. Mehta School of Management, IIT Bombay. So, last session we were discussing on control chart and in control chart there are different types of control chart that also we highlighted in our last session. So, we have just started with a simple variable control chart. So, in that case X bar R chart we are just illustrating.

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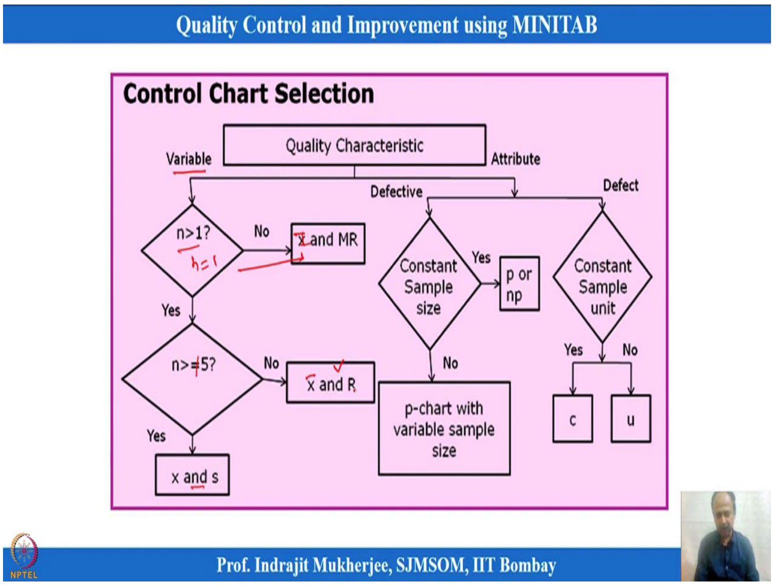

So, let me just recap about the different types of control chart that we have. So, one is variable control chart which we use when sample size (n) is between 1 and 5. So, you can just take this as if n is greater than then we have other options X bar S we can go, but until and unless when n is less than equals to 5, up to that point we can restrict to X bar R charts like that, that is very popular chart, but standard deviation is always a better measure as compared to range.

So, we can go to X bar S chart ok; range calculation is much easier that is why maybe in a shop floor people prefer to use X bar R chart ok. So, in this case and if the sample size is equals to 1; so this is variable control chart when the values of CTQs can be measured and highest level of precision is there.

So, up to least count maybe one decimal place or two decimal place; I can just measure the CTQs and it is a continuous variable; so in that case we can go for X bar R or X bar S depending on the sample size that we have ok. If the sample size is equals to 1 at a given time point; so n equals to 1. So, in this case what will happen is that; we will go to a individual moving range chart. So, individual moving range chart and all these charts that we are explaining over here can detect shift of higher magnitude like that. So, whenever there is a mean shift of higher magnitude, in that case this can be immediately seen; and that will lead to special cause or assignable cause like that. So, that points will go outside the control limit lines frequently; so that will indicate the process mean has shifted. So, I need to take some precautionary action over there ok. So, mean maybe higher than what is expected like that.

So, this control chart gives me a signaling systems; it acts like a signaling system and in that case we can take precautionary measure, whenever I see some points going outside; I can stop the process and find out what is the reason behind that and so that it does not recur and points are within the control limit line ok. So, and one of the control chart that we are discussing is X bar R control chart over here ok.

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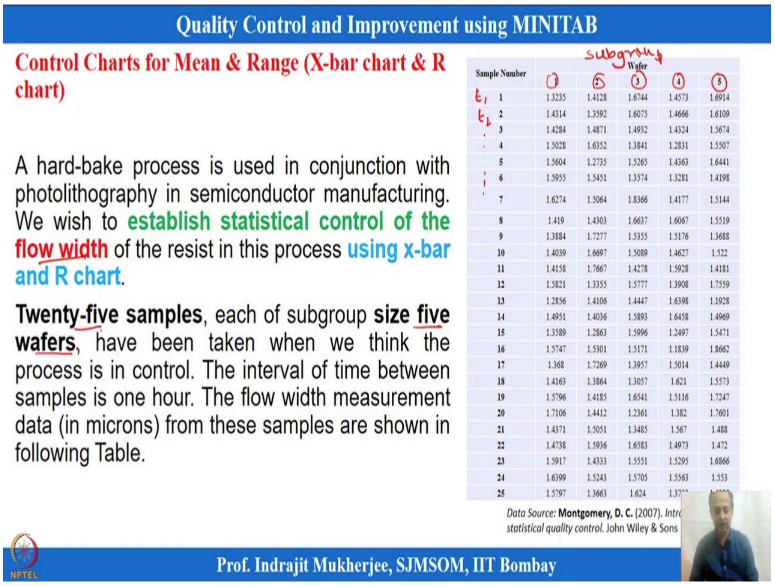

For that, we have taken a specific example from Montgomery's book; so Introduction to Statistical Quality Control. So, in this case flow width is a CTQ that is being monitored and in this case you see there are 25 samples at different time points. So, this is a, at time point 1; let us say and this is at time point 2 like this we have observations and there is a gap between time point 1 and time point 2.

So, that frequency can be decided and those things are decided based on samples to be collected in a specific sheets or in a specific production time point like that ok. So, at a given time point number of samples that we are collecting over here, this is 1, 2, 3, 4, 5 and this is known as subgroup size.

So, this is subgroup size and precaution has to be taken when we decide the subgroup size also ok. Variability within the subgroup should be minimum and between subgroup should be maximized like that. So, that is the condition what is being used when we decide on the subgroup size and cost has to be also considered because more number of samples more costlier it is to measure like that. So, some inspector has to be assigned; so cost will be incurred for inspection and all these things will is there.

So, we have to decide what should be the subgroup size like that, but at a specific time point, 5 is the number of samples that was collected. So, $5 \times 25 = 125$ observations are there over here ok; so 25 samples and size of 5, so 25 is the sample size over here and 5 is the subgroup size over here, 5 wafer is a subgroup size over here.

So, we want to see whether the process is in control or there is some special cause or out of control signals in the process like that; so Shewhart control chart X bar R chart will be used over here. So, then I showed you that how to do that and in that case what we have is that; we have a data set like this.

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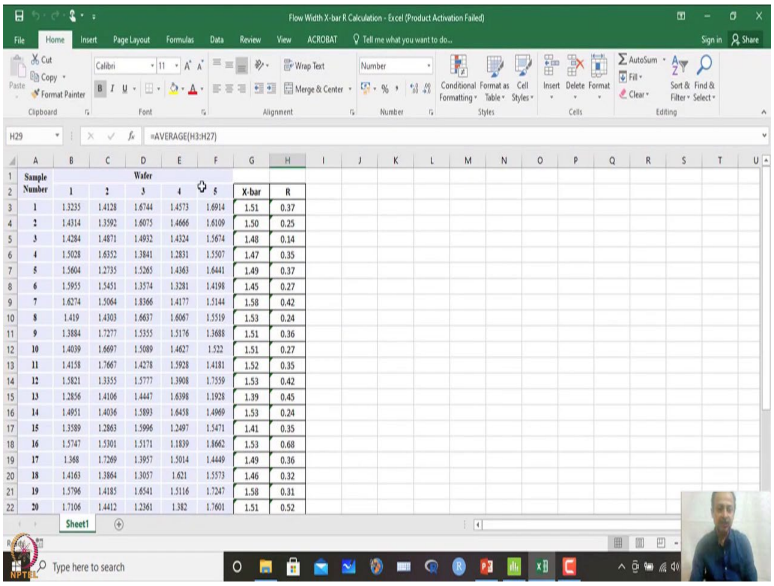

And we can take it to; last time what we have done is that we have taken to MINITAB worksheets like this; this is sample number 1 and 1 to 5.

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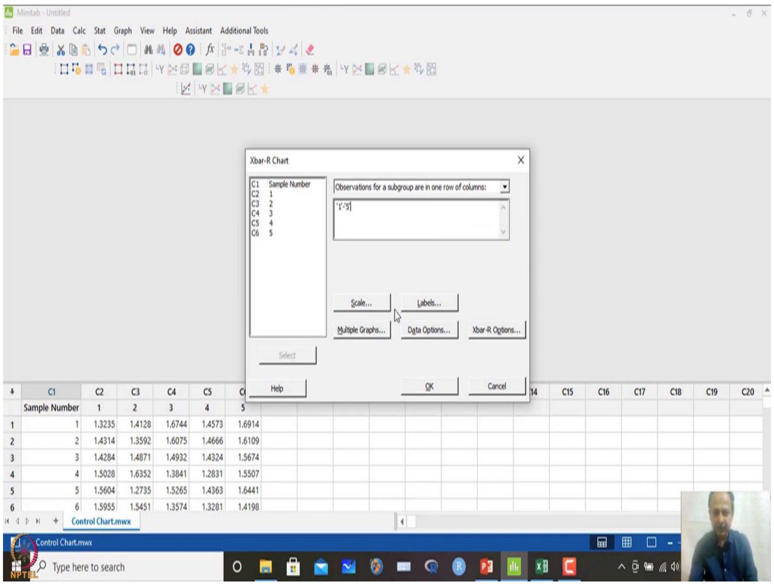

So, these are the sample observations that we have and if these are the sample observations; then we can always calculate the $\overline{X}$ for a given time point. So, at a specific time point we can calculate the $\overline{X}$ and also the range over here.

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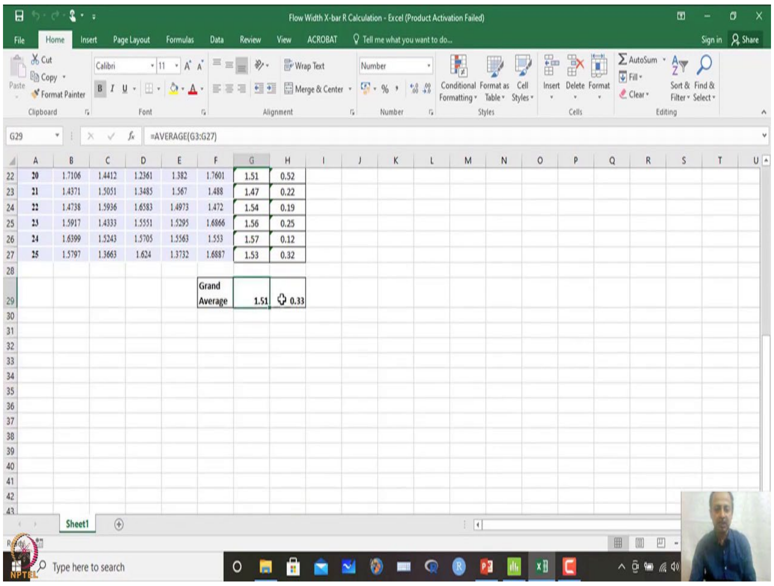

And grand average of these can be calculated and also average of range can also be calculated. These two information will be used when we calculate the natural control limit lines like that which is known as upper control limit line and lower control limit line ok.

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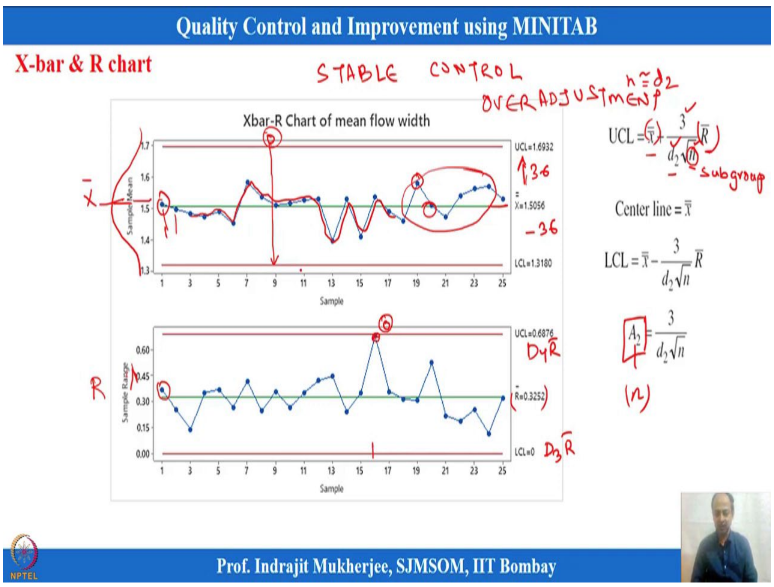

So, when you do that and you calculate the control limit lines. So, I told you that variability of a process is defined like plus 3σ on one side and minus 3σ on the other side like that. So, based on that concept that the variability will be within normal distribution assumptions if we take; 99.73 of the observations should lie within $\pm 3\sigma$.

That concept was used over here by Shewhart and he developed this one control chart and he says that the natural variability of the process should be within $\pm 3\sigma$. So, all the points should fall within these natural limits; so and then he defined what should be a natural limit over here ok.

So, he defined that $\overline{\overline{X}}$ which is calculated from grand average that I showed and the range average is also given over here and one d_2 constant is taken over here and n is the subgroup size. So, this is given in tables and in that case; I can refer n is a function of d_2 is a function of n like that ok. So, upper control limit line is $\overline{\overline{X}}$; this calculation I have from the data set this is also known from the data set and this n so subgroup size is pre decided over here.

Then according to n; we can get what is the corresponding value of d_2 like that or any other constant that we define over here. So, similarly this 3 because this is a constant; d_2 is a constant, n is a constant in a process; so in this case when we collect the data, so we can define a variable which is A_2 over here which is $3/d_2$ and this is also given in table which depends on n ok.

So, this depends on n because d_2 depends on n and all these things; A_2 can be calculated like that ok. So, similarly there is an upper control limit line; so $\overline{R}$ can be calculated over here and this will $D_4\overline{R}$ like that, upper limit line of the range which is monitoring the variability over here. And $D_3\overline{R}$ will be as will be considered as a lower limit over here.

Again $\pm 3\sigma$ concept was used over here to develop this limit lines in this case and this is showing the variability of the samples. So, variation within the samples; so at a given time point, what is the variation within samples like that. So, that is given by range considered range over here and between sample variation is shown over here. So, one sample with other sample; how the process centering is moving over here that issue over here.

Suppose, the centering is moving like this what you can see. So, and maybe this is the center this is a central line; so it is randomly located on both side of the central lines like that. So, not much unusual observations are seen over here and within the control limit line; so in this case we can definitely say that this process is within control and which is and this is a and also in variability also, we can see that the points are within and one point what do you see is the on the line.

So, we can consider on the line as a control points like that. So, if it is more than that; then only we will say that this is typically a signal like that and then we have to take corrective action. So, if it goes outside the line; then we will take precautions like there, on the line we will assume that this is in control scenarios like that ok.

So when we are monitoring X bar ; we are seeing all points are within the control limit line. So, natural variation; so there is no abnormal points which goes outside. So, in this case we can say that the process is behaving normally and there is no abnormal scenarios. Here also we can see that there is no abnormal scenario, so range is also; variability is also within control, within control limit lines over here.

So, we can say that this is a stable process; this is a stable process and under statistical control this is under control statistical control, we can say and so there is no abnormality observed in the process. And in that case we will continue monitoring like that, we do not have to adjust the process variables or process parameters or process setting conditions like that.

So, let it be as it is; so we do not want to; even if there is variation within this what control chart says that there will be variation in the process, but do not unnecessarily adjust the process like that. It is unnecessary because variation is natural over here and within plus or minus 3 standard deviation that is completely natural; so, point to point variation will be there, do not take action when it is within the control limit line like that.

So, over adjustment is unnecessary. So, that is the idea of control charting. So, in this case one is showing change in mean locations like that, one is showing the precision how it is and whether there is abnormality in precision.

So, if point falls outside the any of the X bar R chart or any of the range chart in that case we have to consider. So, at a given time point if range goes outside; that means, at a given time point over here something has gone wrong. So, why variability is high? We have to check and the mean if it shifts to abnormal scenario over here, then we have to check why the centering of the process has changed at a given location like observation over here.

So, I have to see what corrective action can be taken or centering can be adjusted like that ok. So, one relates to centering and one relates to precision; it is not necessary is that when it goes out. So, when it is abnormal in accuracy; then precision will also go wrong like that or goes outside the control limit line, it is not necessary.

But, both can go outside in a specific scenario or individual can go outside in a specific scenarios like that. So, whenever it goes outside; we have to take some corrective action over there ok.

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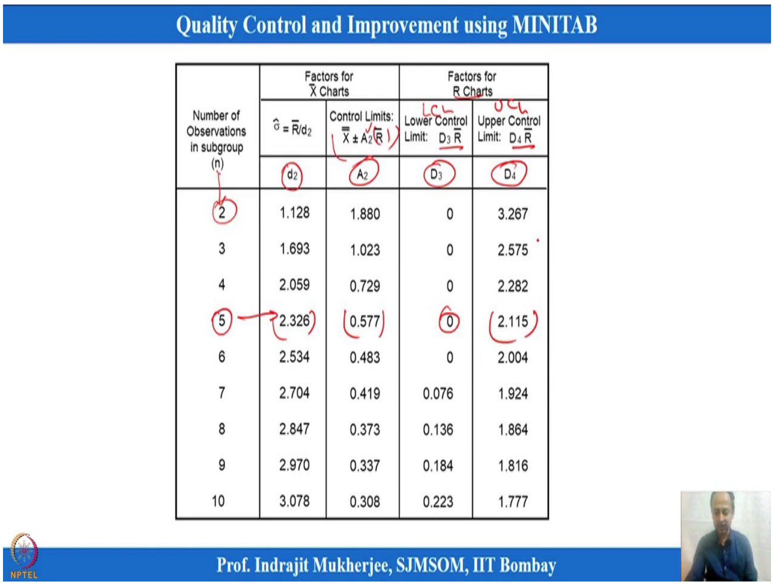

Number of Observations in subgroup (n)	Factors for $\bar{X}$ Charts: $\hat{\sigma} = \bar{R}/d_2$	Control Limits: $\bar{\bar{X}} \pm A_2\bar{R}$	Factors for R Charts: Lower Control Limit: $D_3\bar{R}$	Upper Control Limit: $D_4\bar{R}$
	d_2	A_2	D_3	D_4
2	1.128	1.880	0	3.267
3	1.693	1.023	0	2.575
4	2.059	0.729	0	2.282
5	2.326	0.577	0	2.115
6	2.534	0.483	0	2.004
7	2.704	0.419	0.076	1.924
8	2.847	0.373	0.136	1.864
9	2.970	0.337	0.184	1.816
10	3.078	0.308	0.223	1.777

So, and then this we have considered over here that according to the value of subgroup size over here; we have specific values of d_2, A_2, D_3, and D_4 which is used on a limit line upper control for R chart limit line say $D_4\bar{R}$, $D_3\bar{R}$; lower control limit line. So, LCL and UCL, this is the control limit line.

So, this is $\bar{\bar{X}} \pm A_2\bar{R}$. $\bar{R}$ is known, A_2 is known; depending on the n observation how many observations we have? 5 subgroup size observation. So, we will go on this row and we know the value of d_2 will be 2.326 and this is A_2 value will be 0.577, D_3 will be 0 and D_4 will be 2.115. So, I can calculate the limit; control limit lines for both the charts X bar and also R charts like that ok.

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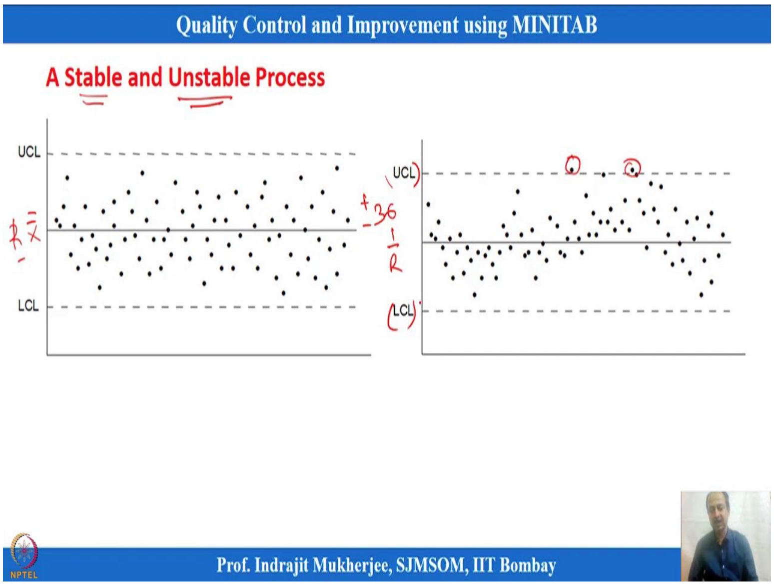

So, and this is a stable process; so whenever I see this kind of pattern where this is the central line over here this is $\bar{\bar{X}}$ condition or R condition over here; whichever chart you are using over here. And points or flow points are on both sides of the central line over here and there is no abnormal pattern that we see over here.

So, that this is a stable process like that, but scenarios can be one point goes outside like this and this is the unstable process. So, we can say stable and unstable process also like this ok. Defining unstable process; there are different ways to define unstable process, I will not go into only I will not go into all the conditions which we say that it is unstable process like that and western electrics are given a guideline.

So, in that case eight different conditions are highlighted; one of the conditions I am using over here which is $\pm 3\sigma$. So, in case it goes outside standard deviation is represented as R over here because range I am using for this. So, in this case what we will do is that in case of $\bar{R}$ over here. So, if it is a range chart like that; so $\bar{\bar{X}}$ we are using also some specific formulas like $\overline{\overline{X}} \pm A_2\overline{R}$. So, that is the standard deviation expression that we are using ok.

So, standard deviation can be expressed as $\overline{R}/d_2$ basically; so that is the expression of standard deviation which we are using in this formulation to define the upper control limit line and lower control limit line like that. So, anyway; so this is the formulation. So, my I only wanted to highlight the stable process and unstable process like that.

Process is in statistical control stable process; process not in statistical control is the unstable process. So, unstability can be defined in various way; we are only defining point going outside the upper control limit line and lower control limit line is will indicate that there is unstability in either in X bar chart or R chart like that ok.

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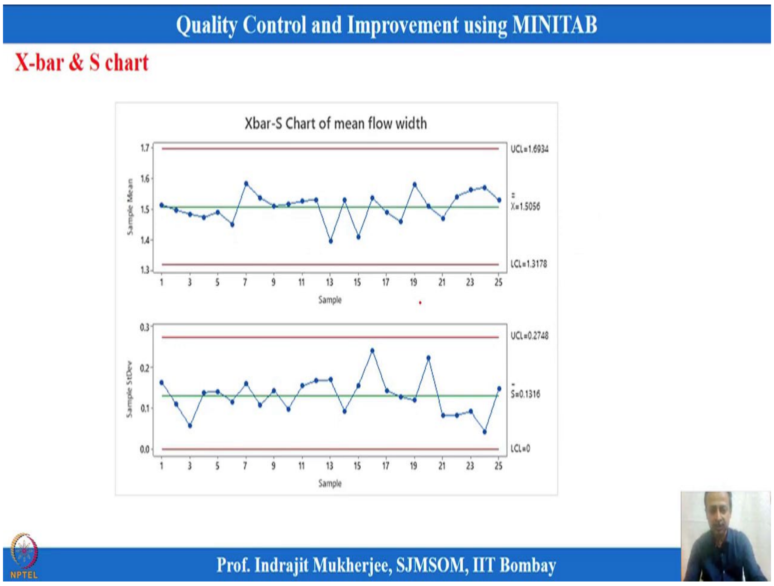

So, this is when we draw the control chart; so in this case what we have done is that we have shown you how to draw this one.

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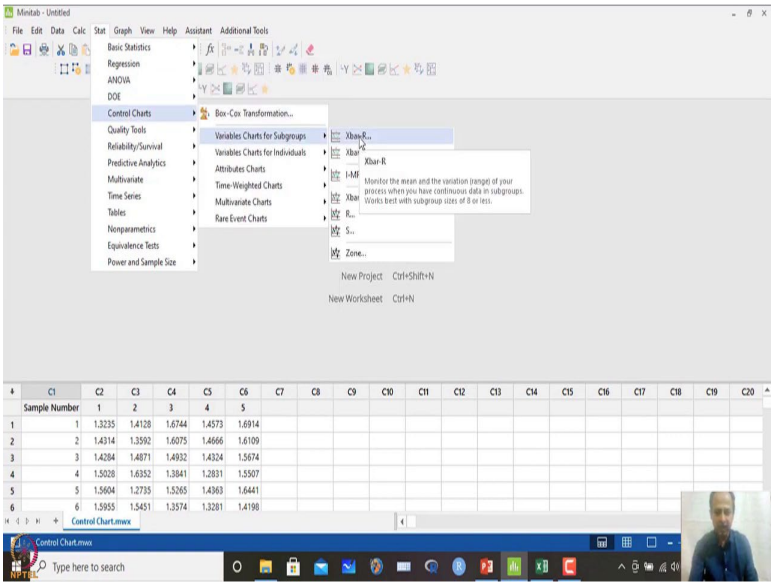

So, I have taken this data set over here and I have named this file as a control chart file which is saved in the desktop and I want to analyze this and draw the control chart. Then, I showed that I will go to control chart, I will go to variables control chart by subgroup. So, I am using X bar R because number of samples is; subgroup size is 5 over here.

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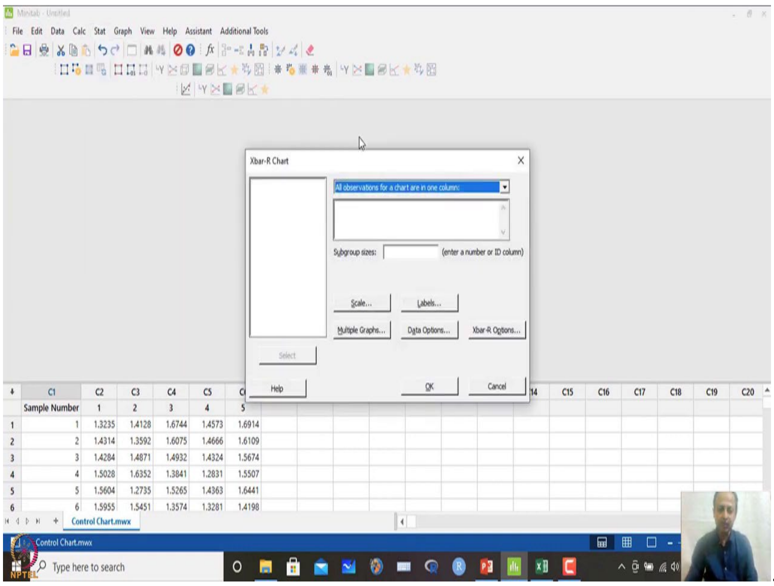

So, I will go do over here options and we will say that it is not in single column; so I will observations are 1 to 5.

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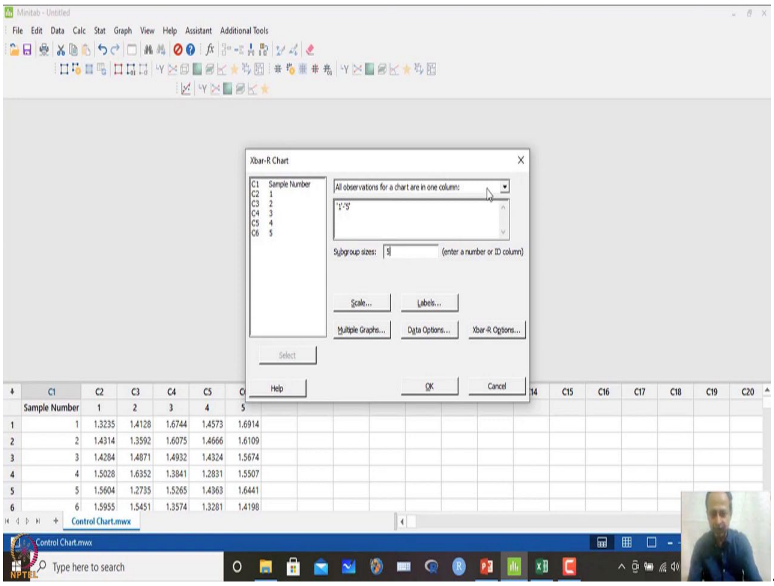

So, I am using shift and I will select this one and subgroup size is 5 over here; all in different rows like that, so I do not have to define like that; so 5 over here.

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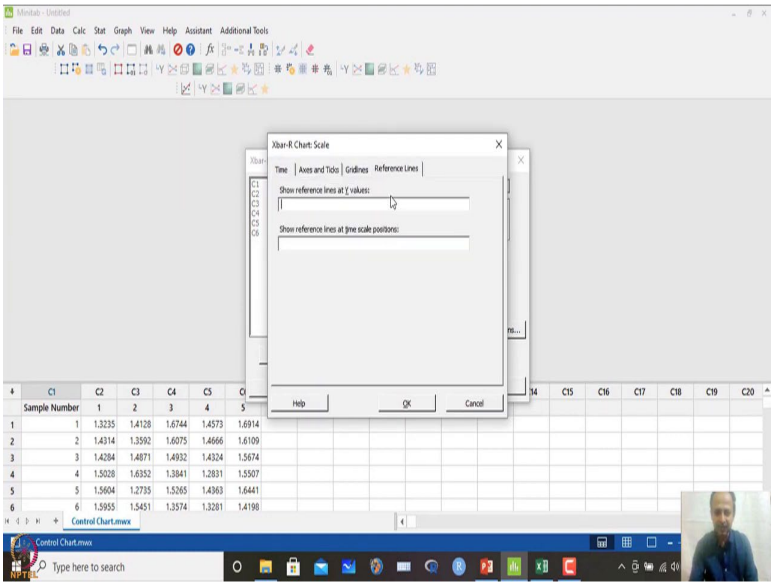

So, I will select this one and scales and all these things reference line; if you want to put over here. So, that is unnecessary we do not want to do that one; these are titles you can add over here.

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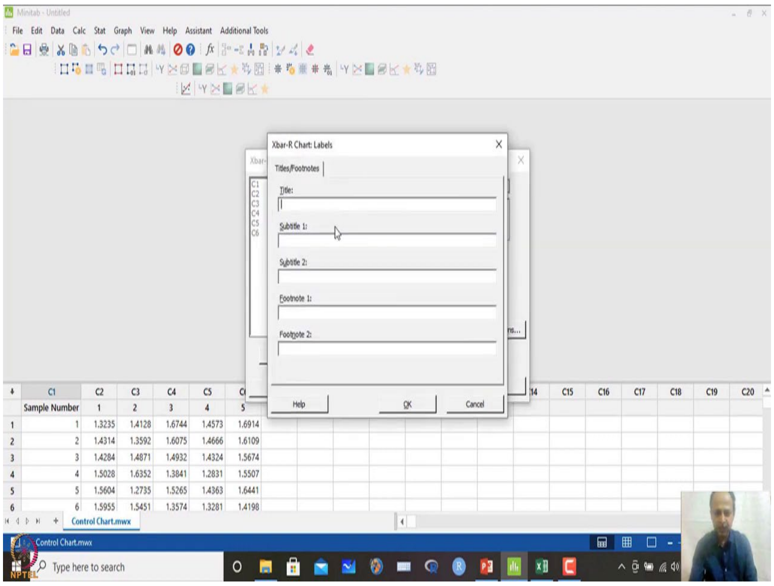

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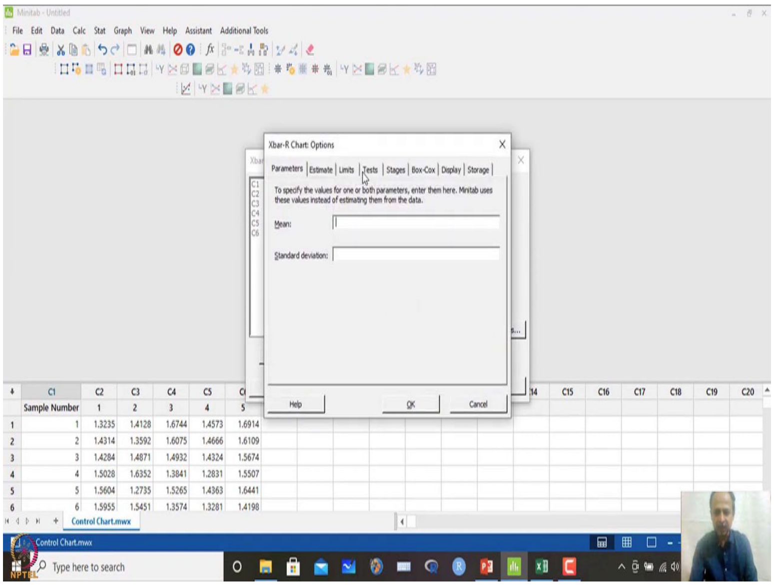

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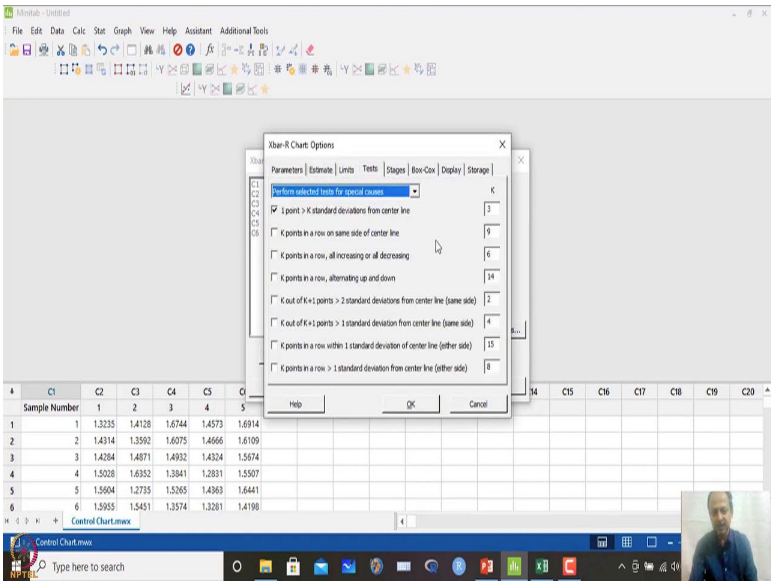

X bar R options; we have to identify test conditions that will say that the abnormal scenarios or special cause is there in the process like that. So, one point going after beyond K standard deviation where K equals to 3, we have taken; that is $\pm 3\sigma$ is the only condition we have taken.

There are eight more, seven more conditions over here we will only use one of the conditions. So, you can see in books; there are other conditions, which says that which is abnormal scenarios or there is special cause present in the process like that. So, I am only using one condition over here that is any point going outside $\pm 3\sigma$ limits.

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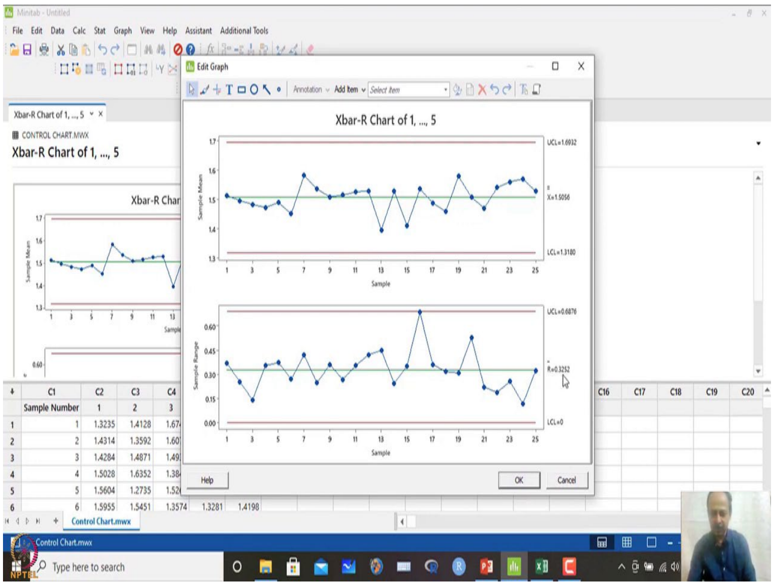

So, and in this case if I click over here; what do you see is that in the session window, you will get this graph in which you have seen that $\overline{\overline{X}}$; in excel calculation is coming out to be 1.51 like that and $\overline{R}$ also we have calculated 0.333 or something like that.

So, if we go to this calculation 0.33 and 1.51; that was calculation and MINITAB also gives you the same calculation over here ok. So, this is the way we plot control charts like that. So, X bar R chart; so any abnormality will be located over here. Let us try to see any more examples that we have and then we can move on.

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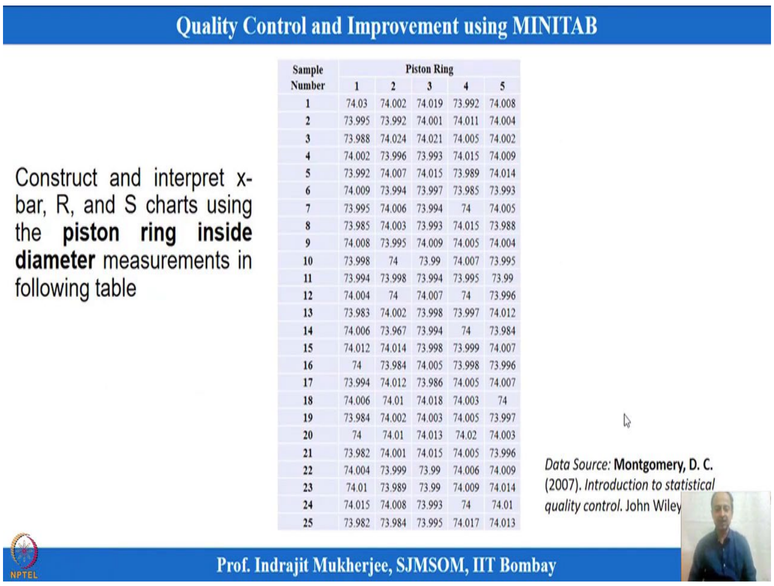

Sample Number	Piston Ring 1	2	3	4	5
1	74.03	74.002	74.019	73.992	74.008
2	73.995	73.992	74.001	74.011	74.004
3	73.988	74.024	74.021	74.005	74.002
4	74.002	73.996	73.993	74.015	74.009
5	73.992	74.007	74.015	73.989	74.014
6	74.009	73.994	73.997	73.985	73.993
7	73.995	74.006	73.994	74	74.005
8	73.985	74.003	73.993	74.015	73.988
9	74.008	73.995	74.009	74.005	74.004
10	73.998	74	73.99	74.007	73.995
11	73.994	73.998	73.994	73.995	73.99
12	74.004	74	74.007	74	73.996
13	73.983	74.002	73.998	73.997	74.012
14	74.006	73.967	73.994	74	73.984
15	74.012	74.014	73.998	73.999	74.007
16	74	73.984	74.005	73.998	73.996
17	73.994	74.012	73.986	74.005	74.007
18	74.006	74.01	74.018	74.003	74
19	73.984	74.002	74.003	74.005	73.997
20	74	74.01	74.013	74.02	74.003
21	73.982	74.001	74.015	74.005	73.996
22	74.004	73.999	73.99	74.006	74.009
23	74.01	73.989	73.99	74.009	74.014
24	74.015	74.008	73.993	74	74.01
25	73.982	73.984	73.995	74.017	74.013

And then there is another example we can take. So, here also construct and interpret R bar and S chart using piston ring inside like that. Here, number of observation is 5; we can use; so they are saying that whether we can use S chart for this also. So, that is also possible; so in this case piston ring example we will take. So, let us take that example and try to do that example also; we can use R chart, we can use X bar S chart also. So, I have certain data set over here which we will use.

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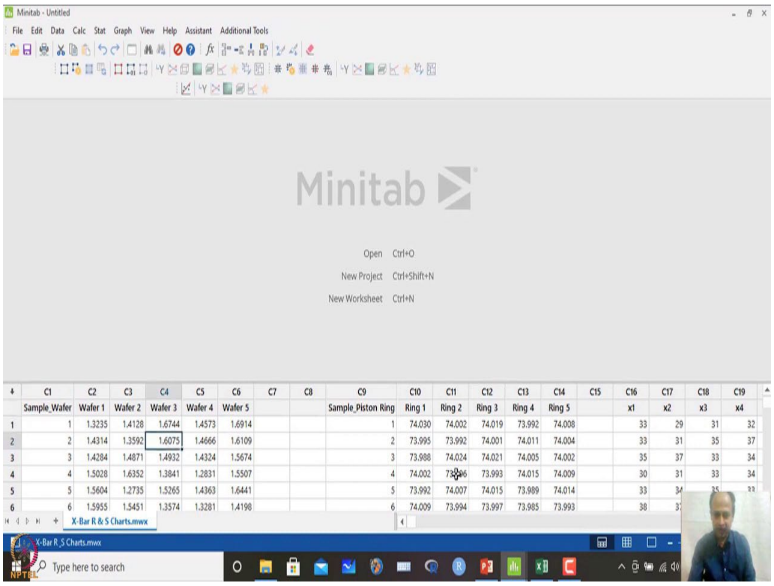

And already saved over here; so in this case what we are doing is that X bar S. So, this is the C9 to C14; this data set is already there. So, this is already I have stored this one. So, piston ring information; some 5 observation over here, subgroup size is again 5 and there are 25 observations over here.

So, data may be coded over here; piston ring dimensions maybe over here or piston ring inside diameter what they have mentioned over here that we are trying to monitor using X bar R or X bar S like that. So, X bar R we know and X bar S is also similar; so in this case we will use X bar is S; S means, they will calculate standard deviation like average; instead of average they will calculate standard deviation over here.

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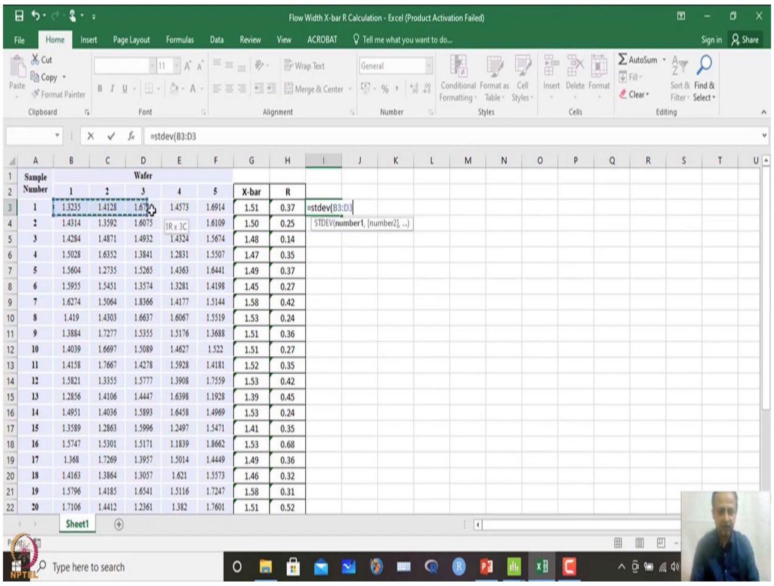

So, which can be calculated as stdev; so in excel we can do that. So, if I write stdev over here and give this option over here, I can get the standard deviation and I know all the standard deviations over here ok.

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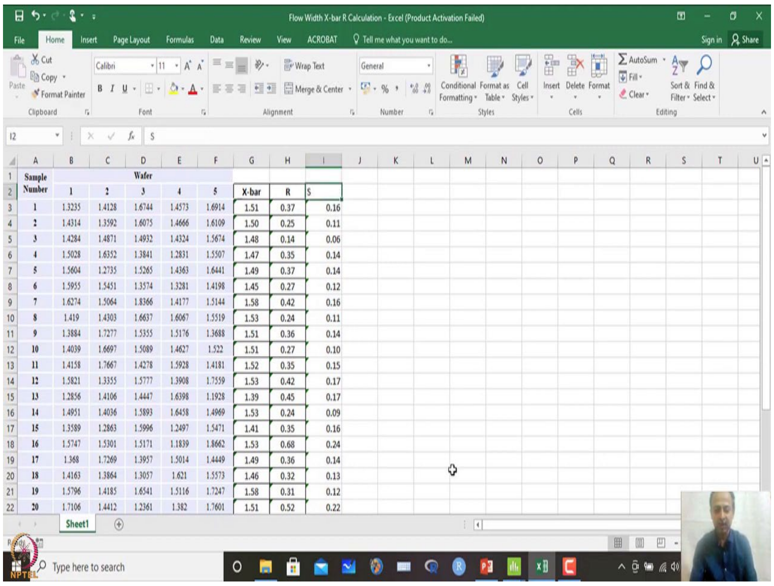

Instead of range; I will monitor, so I can reduce the number of decimal place and this will be as per the least count of the instrument that we are using basically in the process. So, that because up to that least count we can only measure like that. So, we will use that and calculating average maybe one more decimal place we can go because and otherwise we will restrict to the number of decimal place or number of least instrument least count basically ok.

So, this is standard deviation measurements and MINITAB S formulation for X bar R also and that theoretically also it is given; in books S bar S conditions like that. So, we will use X bar S let us say, although the sample size is 5, but let us assume that with five sample size. I want to be more precise, instead of range I want to use standard deviation. So, control chart go to control chart; variable chart by subgroup X bar S.

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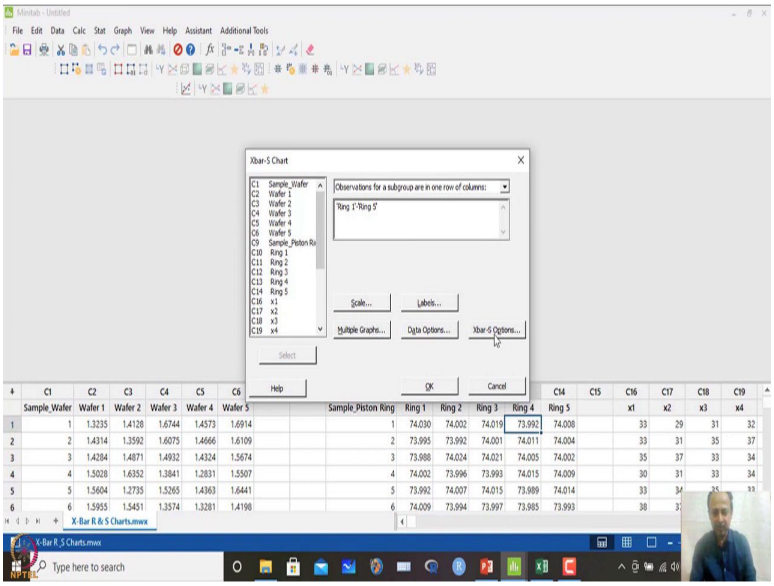

So, whenever I am doing X bar S; it will ask whether this is in one row or different row different columns like that; I mentioned that ring 1 to ring 5 is the subgroup size, you consider this one.

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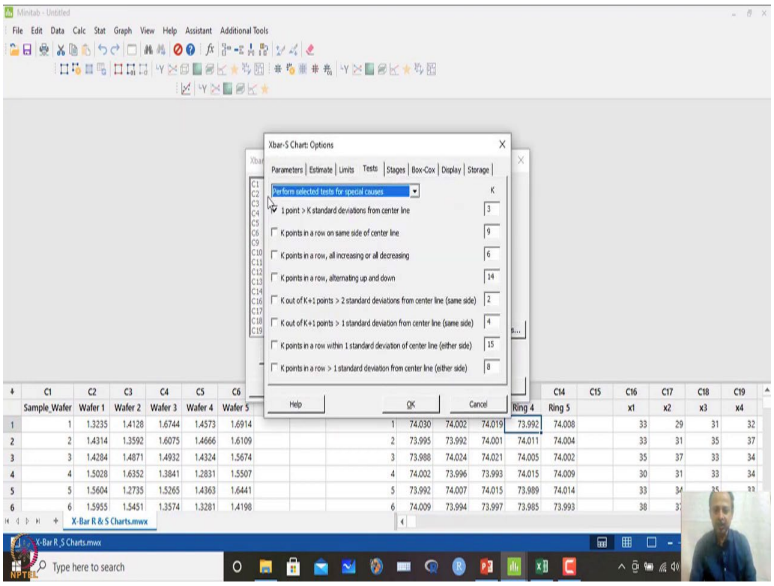

And also X bar condition test only one test; I am considering over here I will click and other things remain same; so we do not want to, so and I will click ok.

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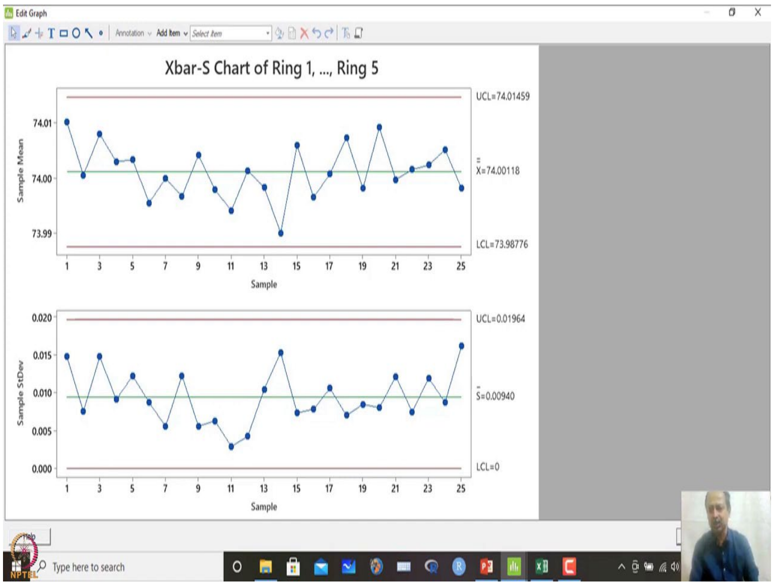

So, immediately I will get the X bar S control chart limits like that. This is $\bar{\bar{X}}$; so this will be the upper control limit line and process seems to be normal and no abnormal observations here we are seeing over here ok. So, favorable scenario; so we do not need to adjust the process because everything is going fine.

So, variability is also within control, accuracy is also within control because everything sample to sample variation between sample variation is also good. And within sample variation is also good which is given over here as standard deviation and that is also monitored over here.

So, accuracy and precision both are monitored in control chart. So, in this case; only thing you have to remember that this type of chart are cannot detects small shifts, whenever there is small variation in the process small shift in the location. So, for those things we have to use other types of control chart ok.

So, here when large shift are there; so in that case these are the control chart which are favored and also we have to understand that the data that we have collected also follows normal distribution; that is another assumption which is also considered in these scenarios like that ok.

So, in case that is not true; in that case we have to use some other means to transform the data and then work on that and see the control limits and accordingly make a judgement, whether a point has gone outside or abnormal scenario is there or not like that ok. Now, this is based on a data set; so what happens is that control chart has to be implemented in the process and for that what is required is that we need to give some prior limit lines like that. So, this may be the first time, you are collecting observations.

So, inside diameter measurements are taken 25 and everything is in control. So, what you will do is that; then in that case what you will say is that to the operator that, let us use this control chart and you will mention only the upper control limit line over here and lower control limit line and maybe T26 onwards, use this limit lines to monitor the process again ok.

So, because there is; this is natural variability what we are seeing, so this variation can be used to express the natural limit lines like that UCL and LCL. So, in this case what we will do is that; we will just take the average values over here 74.00, what you see and we will ask from operator that from 26.

Next observation what you do is that, I have given you these control limits and next data what do you get five samples subgroups; you just take and then see what is the $\overline{X}$ and what is the range and see whether it is within this control limit line or not. So, initially I have to develop this control limit line ok; this is a favorable situation in this case, there is no problem.

So, in this case I can directly say that I have much observations over here and there is no abnormalities over here and we are assuming that this follows normal distribution. So, in this case; what we can do is that we will just say that take UCL as 74.01; if least count is up to second decimal place like that.

And average is 74 and lower control limit is 73.98 or we can write we can use over here as up to two decimal place; 73.98; we can freeze this one or maybe some relaxation; we can give and say that some constraints some pressure on the process. So, 74, we can mention over here 73.98; that is fine because $\overline{\overline{X}}$, we are keeping 74; so least count up to second decimal place over here; so we can mention that 73.98; we will freeze over there ok.

So, 74.01 over there; so and 74 and then 73.98 will be the lower control limit line over here ok. So, gap is very less in that case we can we cannot round off the figures over here; so because it is very sensitive in this and the data are very very close over here so, in this case.

And when the data variation is less in that case; we will find that the stretch between upper limit line and lower limit line is also close basically and that is also true for range or standard deviation, if the data is not varying much. So, in this case third place of decimal you see; a standard deviation average of standard deviation is 0.009 and then it is from 01 to 0 like that. So, from 0 to 0.01 and an average value is 0.009.

So, precision is very much precision is over here. So, in this case not much width is there between upper limit line and the lower limit line over here ok. But scenarios may not be so favorable and when you collect the data and first time you go to the data. Collecting the data, what can happen is that process some of the points can go outside the limit line and when we have not implemented any rules like that; so operator also does not know.

He I will go to the process and say that please collect the data 25 observations and or 20 observations like that and then give me the data points, I will give you the control limit line after a certain time point. So, let me just analyze the data and I will give you some control limit lines like that; then you monitor subsequently you monitor the process, according to the control limit line.

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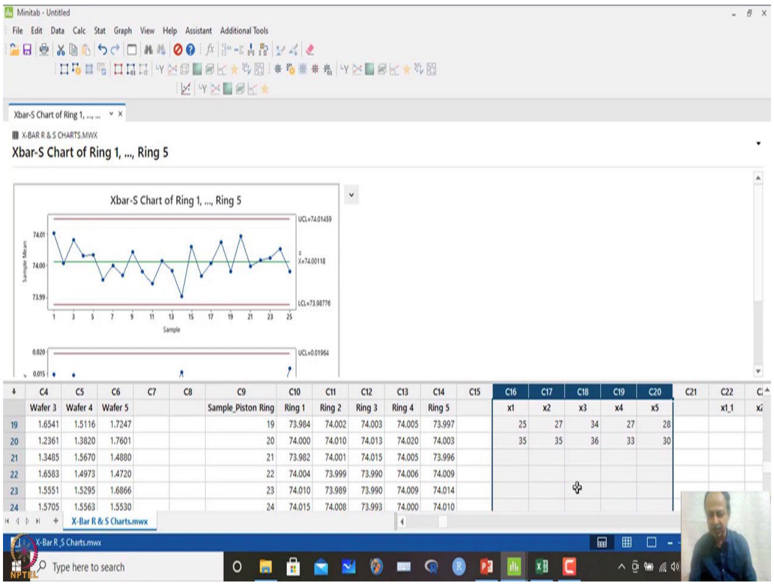

So, one of the example again from Montgomery; I have taken over here; C 16 to C 20 over here and we are trying to establish a trial control limit line; we are trying to establish how they does trial control limit line.

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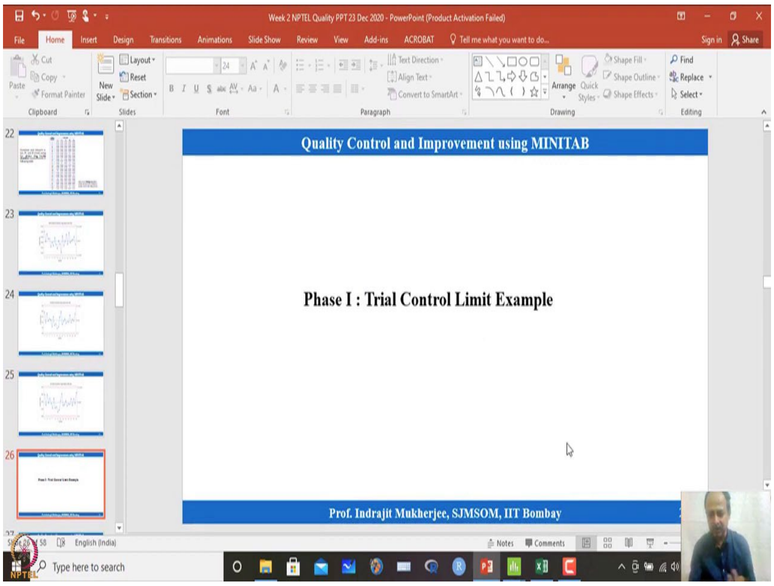

So, this is the overall objective that what operator receives from the process engineers or something on who is knowledgeable about control chart; he will only receive a upper limit line, lower limit line, central line and he will be asked to monitor the process like that. How it is calculated; then we have to understand, how these trial control limit line has given in phase I.

So, phase I control charting which is the first phase where control charts are upper limit line, lower limit lines are developed; at this stage these trial control limits lines are given and how it is given? We should understand.

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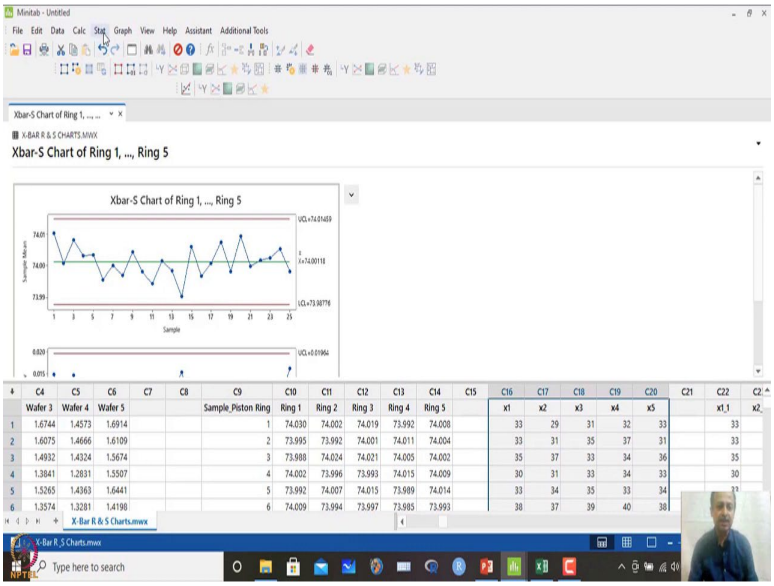

So, this is one data set where subgroup size is 5 and I have a data set of 20 observations like that. So, this is when we measurements or which is taken from Montgomery over here; so this is the data set that is taken. And in this case, if you draw this control chart over here; so I will just eliminate the previous one. So, and analysis; so I am drawing the control chart variable with subgroups.

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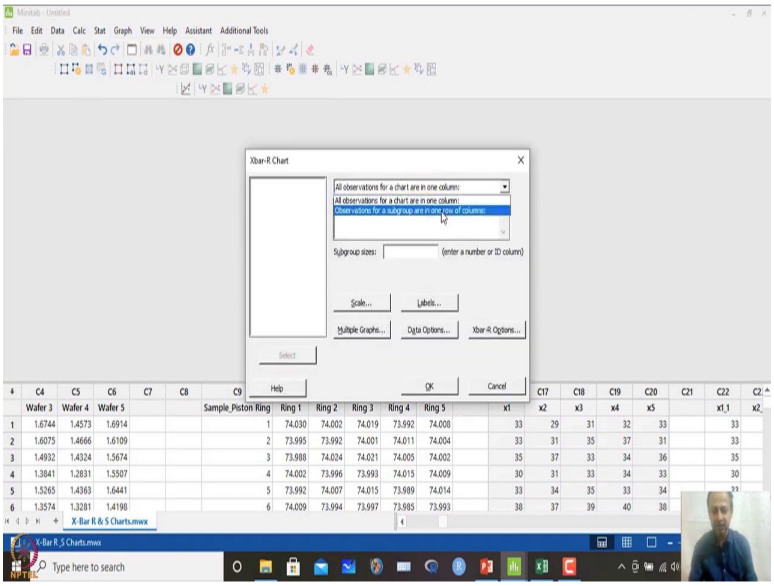

So, let us draw X bar R chart over here which is the simplest one and let us take this, x 1 to x 5 observations.

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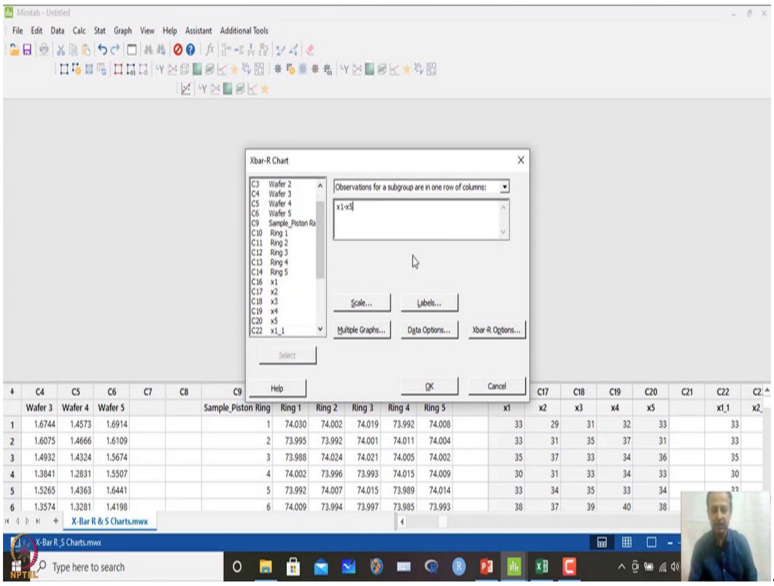

And let us try to see what is happening. Because this I have told the operator that just collect the data and give it to me, I will give you the control charts; I will give you the upper limit lines and I will do that ok.

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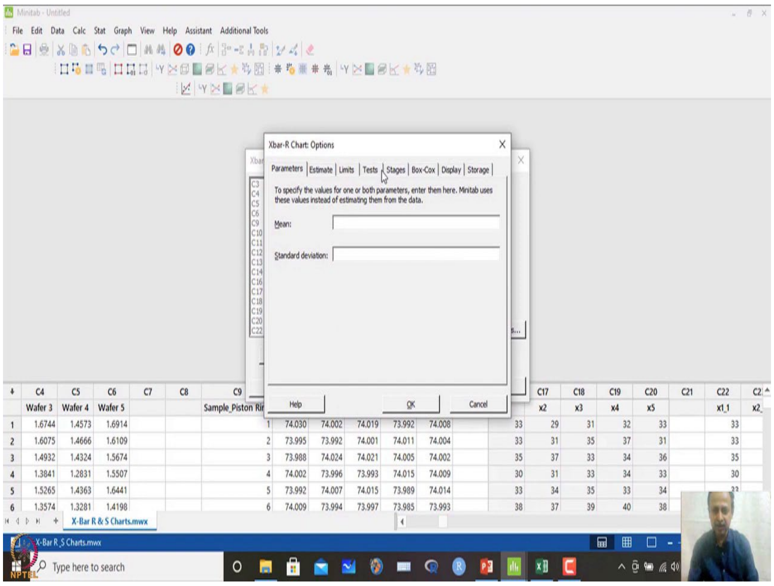

So, conditions is same; so in this case I have used the same conditions over here and I have clicked ok.

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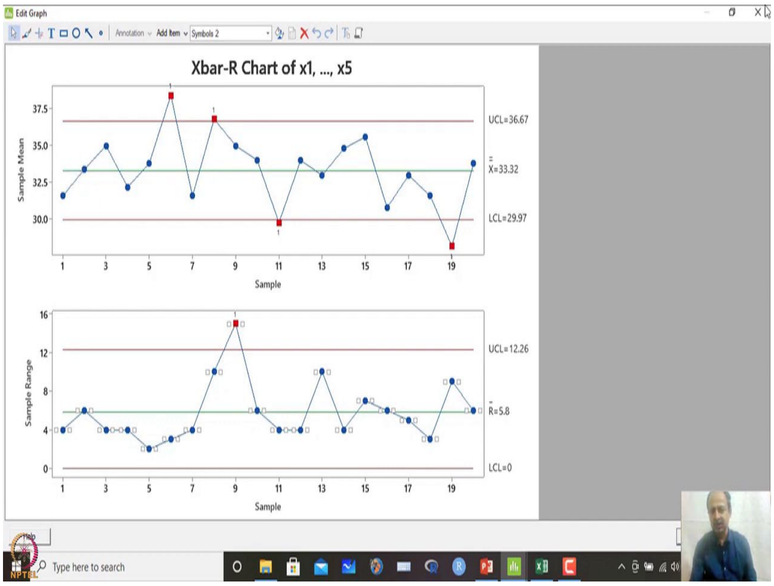

And when I do that, what I observe is that some points are going outside over here. So, how many points? One point is over here, one point is over here, one point here and we have identified this point which is going beyond the control limit line like that ok. So, four points over here and there is another point which is this is a fifth point.

So, this is one point here you see that one has gone outside in the mean or average X bar chart, but variation is not gone outside; so range is ok. So, second one is again shift of mean and this has not variation for; this corresponding variation this one point and this is corresponding point what you see; sample number 8 and sample mean is 36.8.

So, this has gone outside because my limit line is 36.67; so this has gone beyond the limit line and here also third point, fourth point like this and variability over here is quite high; what you see sample number 9. So, and this is sample number 8; so sample number 6, 8, 9 and then we have sample number 11 and this is sample number 19.

So, all these are 1, 2, 3, 4, 5 points has gone outside like that ok. So, in this case what happens is that; this is unnatural, so I cannot consider this you calculate the control limit line and this is what was; what operator has given. What has happened actually we do not know, but these are abnormal conditions.

So, what we have to do is that; we have to eliminate this point to calculate the natural limit line. We will assume that action is being taken and this is not the natural variation; natural variation are those points which are within the limit lines like that ok, then what they will do is that they will just eliminates all these out of control points.

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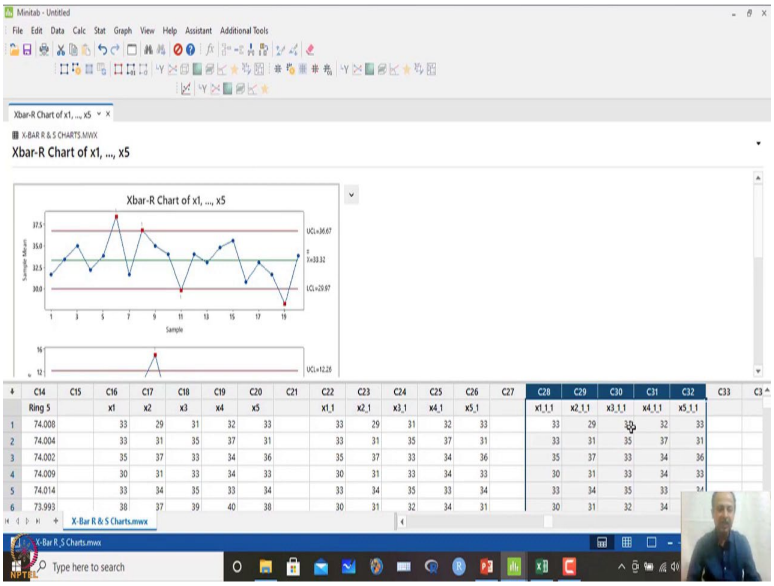

And this is shown in C22 to C26, all these points are removed and we have observations like 16 observations over here. So, we have all here 20 observations; may be 4 observations are removed over here and 5 observations. So, this is the final one we can see; C28 to C32 where one more observation was also removed and this is the final one because 5 observations are out of control; so we have just removed those points, those rows we have removed.

So, all these points from the data has been removed or cleaned like that and then we try to see what is the natural variability on the process. I go to control chart; variable control chart X bar R.

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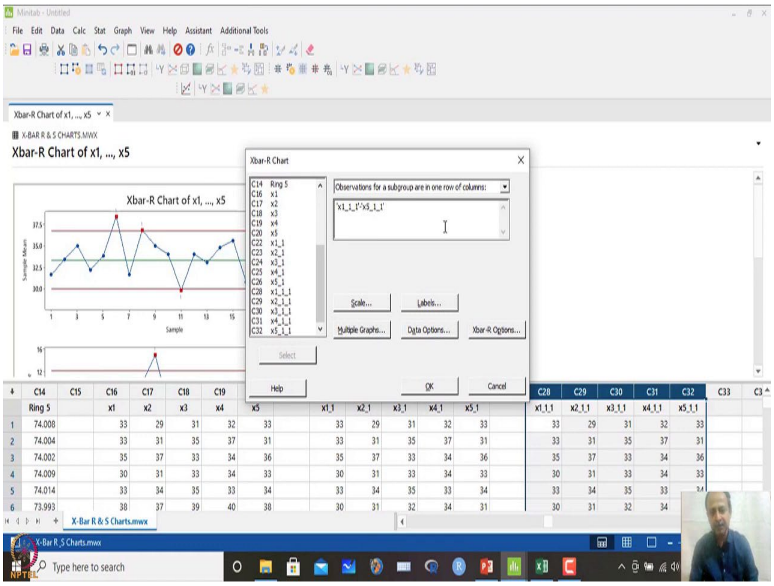

And then what I do is that; I remove this one and I take the last data set which is cleaned and then I select this one and then condition remain same.

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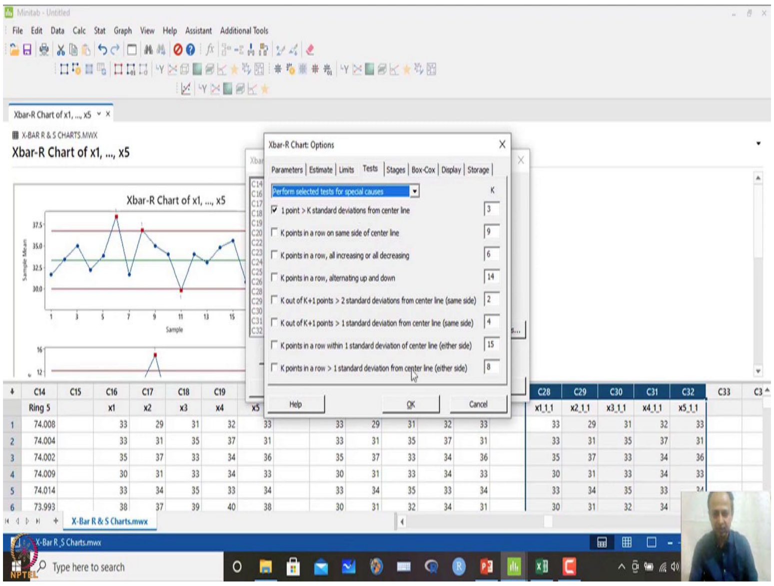

So, here also condition I update test condition remains same; one point going outside.

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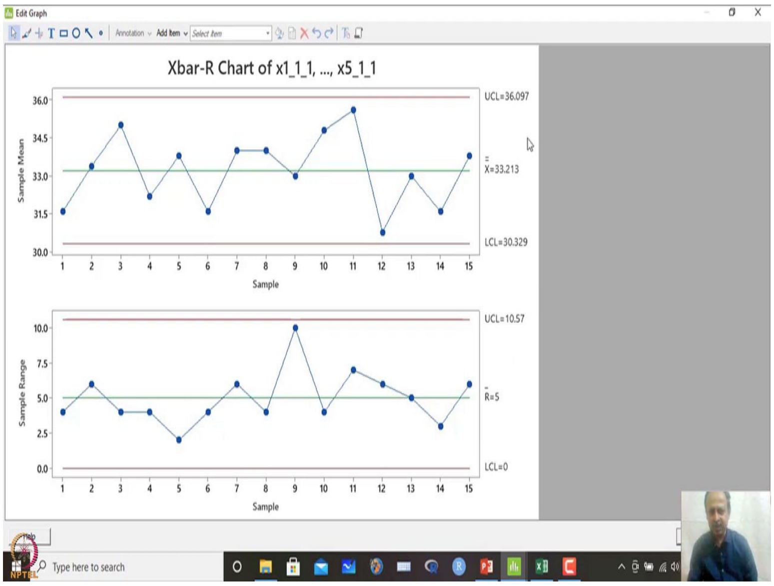

And when I click ok; what I observe is that, I observe that this is the final graph that we are getting. We have eliminated five points and then after we have eliminated five points, we see that all the points are within control limits. So, this UCL that we get, LCL that we get is having natural variability only within this; so there is no abnormal scenarios.

And this chart with no data plotted over here; so central line and upper limit line, lower limit line this will be delivered to the personnel who will monitor the process with respect to time in future like that. So, we take a preliminary data and then analyze the data; if there is out of control points, we remove those points.

And then we recalculate the limit lines and until and unless all the points are within the control limit line, we keep on doing this. And up to 20 percent, we can eliminate the data, that is the thumb rule we can take and then we develop and in case it is more than that; we what we have to do.?

We have to correct the process and again collect the data and try to see that something is; we need to assignable cost needs to be removed. And then we have to collect again data and try to eliminate other special cause or abnormal scenarios like that; we have to prevent those things and then collect the natural variation of the process. So, then we can have a control limit line.

So, phase I is very critical because we are giving the limit lines over here and if the limit lines is based on abnormal scenarios; then that will increase the width of the upper limit line and lower limit time; so that is not natural basically. So, we need a natural variability in the process which will define the control limit lines like that ok.

So, that way trial control limit lines are developed; whether it is X bar R, whether it is X bar S. So, with that we will stop over here and then we will consider a scenario when we have one observation, what I told is individual moving range chart. So, in next lecture subsequent lecture; we will deal with other types of control chart and maybe IMR is the first one we will deal with ok.

So, thank you for this listening to this session; we will continue from here. So, trial control limit lines and beyond, we will see some of the control charts which are generally preferred and used in manufacturing or any other industries like that ok.

Thank you.