Manufacturing System Technology - II
Prof. Shantanu Bhattacharya
Department of Mechanical Engineering or
Industrial and Production Engineering
Indian Institute of Technology, Kanpur

Lecture – 20

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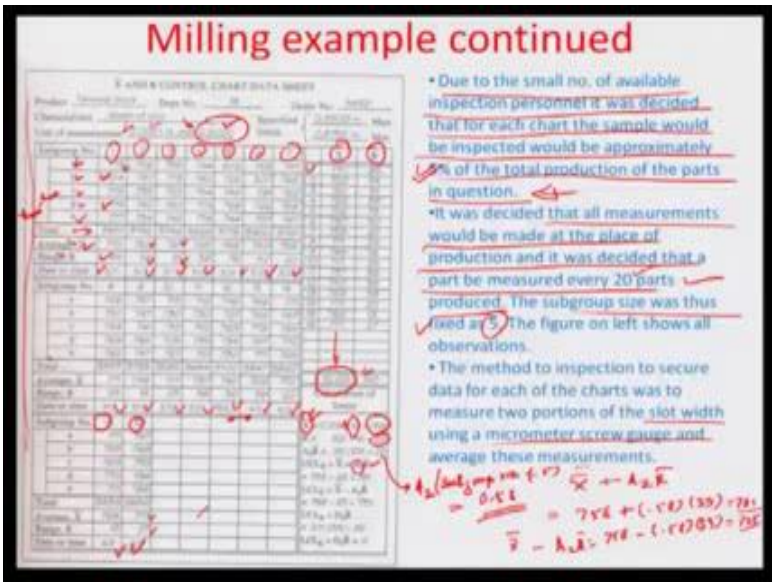

Hello and welcome to this manufacturing systems technology part 2 module 20. We are going to learn out plot or how to record the data, so that we can plot it in the control charts. So, I think I had discussed this earlier in quite bit of details the many examples where we are talking about this terminal block slot, and we have recorded them as sub group various sub groups, and each sub group has about 5 observations as you can see a to e. And the units of measurements are recorded as 0.0001 inches over this 0.8000. So, this is something which we are doing just to prevent the redundancy of calculations, I had shown you earlier that in such cases you have to do a transformation, you are basically doing the transformation by deducting 0.8000 from the 0.8750 mean value, and then multiplying this with or multiplying this with 10 to the power of 4.

So, that you can have real values which are fit for calculations etcetera, and then you can do the transformation back again once you have been able to generate the information on the mean in the standard deviation through his statistical method. So, you can see here there about close to 15, 16 sub groups which are available and they have been recorded at different points of time. In fact, this is data for closed to about you can say you know

let say it started from 3, 7, so basically seventh of March all the wayed about third of April. So, its near about one month data that we are talking about, and there are you know not all days on which the data has been taken, basically it has been taken on seventh of March 3 times or 3 sub groups again eighth of March 3 times or 3 sub groups again ninth of March again 3 times 3 sub groups similarly tenth of March and then it has been taken on the second of April again 2 times, and third of April 2 times to probably there was some degree of control of the process, which was executed in this process and they found out that on third on tenth of March probably the process was back to control. So, they again checked it once in a while for again, you know 2 subsequent days in the month of April.

So, having said that if you look at the various observations which have been made here this represents 0.8772, and because of the transformation done here it is shown as 772, 8 0 4, 7 7 9, 7 1 9, 7 7 7 7. So, this is how you have calculated. So, basically it means 0.8774 sorry 2, 0.8804 0.8779 0.8719 0.8777 is over and above 0.800, and multiplied by 10 to the power of 4. So, that you can have this has factor coming out. So obviously, the total is calculated here of all these values. So, that you can calculate the average and the range basically is the maximum observation minus the minimum observations.

So, in this particular case the maximum observation is 804, and the minimum value is 719. So, that brings about close to 85 you know as the range. So, that is how you have calculated the x bar and the R here for all these different distributions. So, you have 750 and 54 as sub group 2, 751 and 51 as sub group 3 so and so far up to 777 and 27 has sub group 16 so and so forth. So, therefore, you know record all these different 16 observations on a vertical table in terms of the x bar and the R charts. And you calculate the means of mean you know, so basically x double bar, so the mean of means, so the total here happens to be 12, 129. So, you divide that where the number of observations or sub groups that is 16 and record this is 758. So, that is the mean of the means and the average range which comes out to be 621 by 16 which is about 39 in this particular case, so obviously, because we are talking about sub group size of 5.

So, you know in the x bar chart this table this data is available in the tabular manner which I am going to share later, but then you know a 2 basically which is the coefficient of the deviation of the range with respect to the mean of means is actually function of this sub groups. So, the a 2 for a sub group size of 5 for a sub group size of 5 is recorded as 0.58. So, therefore, you can have the 2 limits defined as x double bar plus a to R bar

which is actually in this case 758 plus 0.58 times of 39 which is the R bar. So, this comes out to be 781 and the lower limit of the x chart happens to be x minus a to R bar which is 758 minus of 0.8 times of 39, which is actually equal to 735. So, that is how you basically find out the upper and the lower control limits in this particular case. So, that is the modalities part. Now due to small number of available inspection personal it has been decided here that for each chart the sample would be inspected approximately 5 percent of the total production on the parts and question.

So, this number which is actually coming that is sub group of 5 and x number of times its being repeated during a day that is essentially the 5 percent production limit, that is 5 percent of the total production limit that is used for determination. So, it has been also decided that all measurements would be made at a place of production, and it was decided that a part we measured every 20 parts produced, because its 5 percent, so obviously, out of 100 5 out of 100 and one in every 20 parts. So, therefore, the sub group size was sort of fixed looking at this 20 parts one in 20 parts as sort of 5 you know. So, figure on the left shows all the observations here. So, the method to inspect was really to secure the data for each chart and was to measure 2 measure the 2 portions of the slots width using micro meters screw gauge average these measurements. So, these are actually average measurements. So, that is how the modality was and this is how the control chart is…

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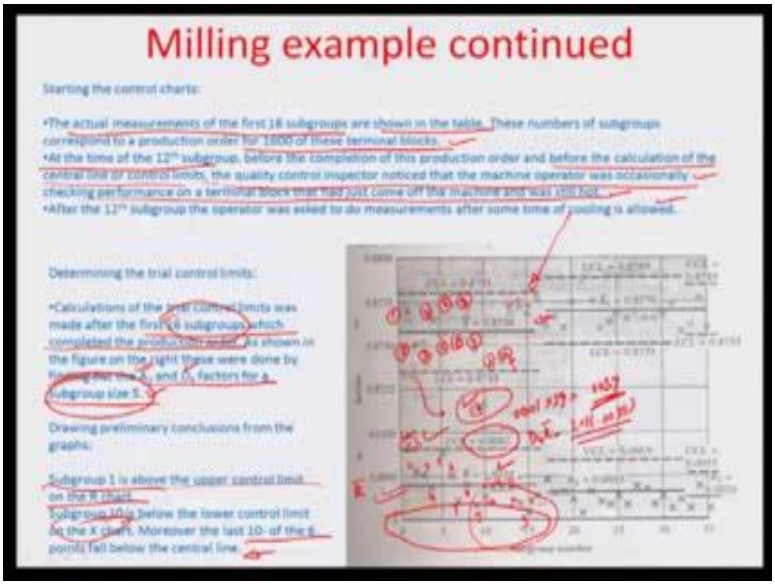

So, having said that we from this data borrowed from this table controlled table, we start plotting the chart, so the limits 0.8781 which is transformation into the upper limit which

was obtained here 781. So, basically it is over and above 0.800 and it is multiplied by 0.0001 times of 781, this is the transformations, so 0.8781. So, this is the upper limit and similarly 0.8735 is a lower limit. So, that is how we have plotted both the lines here 0.8781 and 0.8735, and obviously the central line is corresponding to the mean the mean of means that is x double bar 0.8758. So, the actual measurements of the first 16 sub groups are shown in this particular table, the numbers of sub groups correspond to a production order of for 1600 on these terminal blocks.

So, therefore, the sub groups correspond to 16 times 5 about 80 parts which is about 5 percent of this 1600. So, that is exactly complained with the norms of recording 5 percent of the total production limit as decided in the control charts scheme. And we can see here the plot of the x bar corresponding to the different values recorded; for example, in this particular case the x bar comes out to be 0.8770. So, you can see this point to be 0.8770 as the first sub group, it is quite away from 0.8758, as you can see this is again the second sub group which corresponds to the term again, if you look at point 0.8750. So, it is below the 0.58 sub groups. So, is below here. So, this is the second point, then the third point correspondingly the fourth point, fifth point, 6 point, seventh point, so and so far.

So, basically what you are trying to do is to plot these 16 sub groups, as you can see has recorded here as x bar you know… So, that is how you are recording all these 16 sub groups. So, therefore, it is very obvious to record all this you know in a control chart domain as UCLL and CL. And similarly there are certain aspects which can be noticed, so at the time of the twelfth sub group. So, this about this particular sub group before the completion of the production order, and before the calculation of the central line for the control limits, the quality control inspector noticed at the machine operator was occasionally checking performance on terminal block there head just come of the machine and was still hot. So, after the twelfth sub group as you can see suddenly there is a change in the overall level of the measurements, because of this additional factor of the cooling which has been introduced into the measurement system.

So, it is basically very much visible what about decision making, we are taking to control or modify the way that inspection is carried out or even the control chart is plotted, it is being recorded very judiciously in the control chart, and it comes out because of the process you know it is very full proof. So, in a neutral we had about 16 sub groups, and the sub group size was determined is 5 for which we calculated a 2 and d 4 factors for the

x double bar and the R charts.

So, now will plot the R bar chart, so obviously, the R bar or the range bar was determined from this particular value here as 621 divided by 16 that is 39. So, if I just do the transformation on 39; that is 0.0001 times of 39 whatever is the transformation allowed the range chart comes out to be mean or centered about 0.0039, which is being illustrated here. And if we had sub group size of 5 the lower level of the range chart is really eliminated because it is above the sub group size 5 that you consider the lower range, but the upper range can be represented by in this particular case the d 4 co efficient times of R bar, and d 4, in this particular case comes out to be about 2.11 from the table that is have been considered, so 2.11 times of 0.039, that is close to 2.0082 and that is the upper control limit for the range chart.

So, essentially this crosses, now are looking at the different sub group ranges which have come out, and if I may recall that these were the ranges which were plotted here as 0.0085,0.054, 0.0051, 0.0036, so and so far. So, those are being plotted as sub group 1 sub group, 2 sub group, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15 and 16. So, that is how you are plotting the different 16 sub groups, what is important here is sub group one is above the upper control limit on the R chart, that is what you can see right away upper control limit is 0.0082, and the data that was recorded was 0.0085. So, it is well above the upper control limit of the range chart sub group 10; for example, is below the lower control limit on the x chart. So, this write here the tenth figure is actually below the LCL on the x chart more over the last 10 of the 6 points fall below the central line.

So, if you look at the way that you know this chart has been plotted the range chart; for example, if you look at let say starting from 16. So, sixteenth, fifteenth, fourteenth, thirteenth, twelfth, eleventh, tenth, ninth, you know till actually ninth all these different values at least 6 values they are falling below the R bar or the mean of the R chart below the central line. So, in way the range is not showing control adequately whereas in the process or in the sub group 10 the observation really goes beyond the LCL. So, its unavailable to rejection at that particular stage. So, the control chart gives you some estimation or some data regarding, you know the interpretation regarding how the data etcetera is plotted.

So, having said that now I would just like to close on this module in the interest of time, but in the next module we will discuss how because of some changes there would be

shift in the way that we are plotting the control chart, and consequently what would happen in terms of the process control during that illustration. So, as of now thank you very much, we close this module.

Thank you.