Six Sigma
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Lecture – 58
Acceptance Sampling: Minitab Application

Hello friends, once again welcome you to the journey of Six Sigma. And we are in the final phase of our DMAIC cycle, that is the control face and this is the lecture 58 in the control face. And I would like to demonstrate the application of Minitab software for conducting Acceptance Sampling. So, we have discussed in detail statistical quality control is divided into two part: one is statistical process control, where we talk about the control charts for variables. And control charts for attributes and the second part is acceptance sampling, where we talk about the acceptance sampling plan for attributes and acceptance sampling plan for variables, we have covered the entire gamut of statistical quality control in greater detail.

Now, if you are a practicing person or if you are university student and executing some project and dealing with the large data set, then it may be cumbersome for you to do the calculations by hand. And in this case you can easily use Minitab for conducting the analysis and spare more time on the interpretation.

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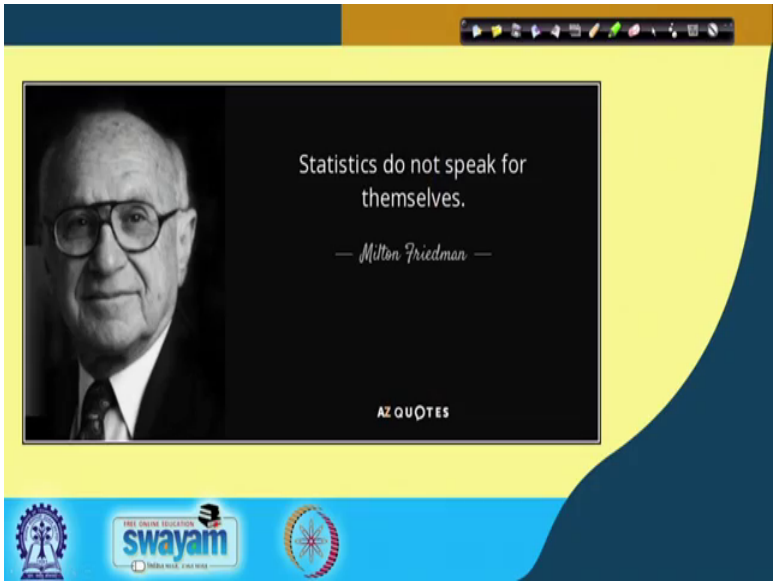

So, statistics do not speak for themselves we have to have guts, intuition and process knowledge, to make the necessary inferences.

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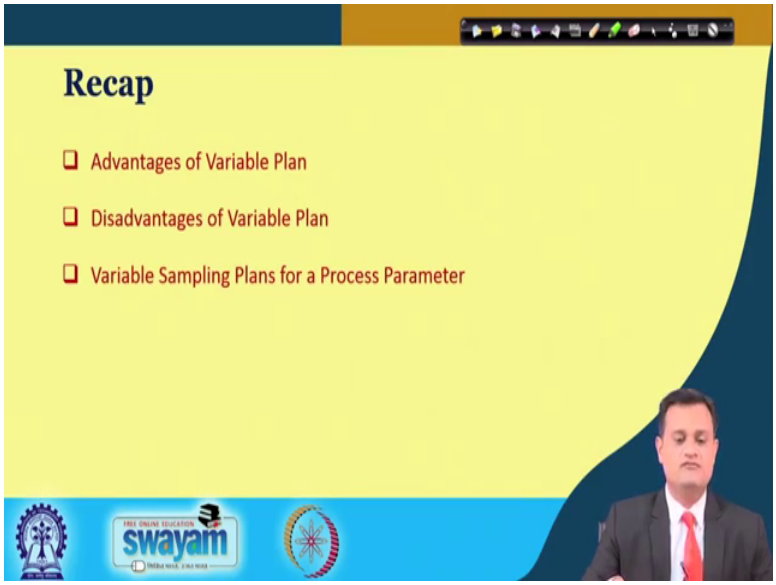

We talked about advantages disadvantages of the variable plan and we discussed 3 different cases if you recall variable sampling plans for process parameter; case 1 single specification limit, process standard deviation known. Case 2 double specification limit process standard deviation known, case 3 you have single specification limit process standard deviation unknown.

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So, we had discussed this in detail, now this part we will cover basically steps involved in acceptance sampling by attributes in Minitab, steps involved in acceptance sampling by variable. So, I will try to cover both attribute as well as variable.

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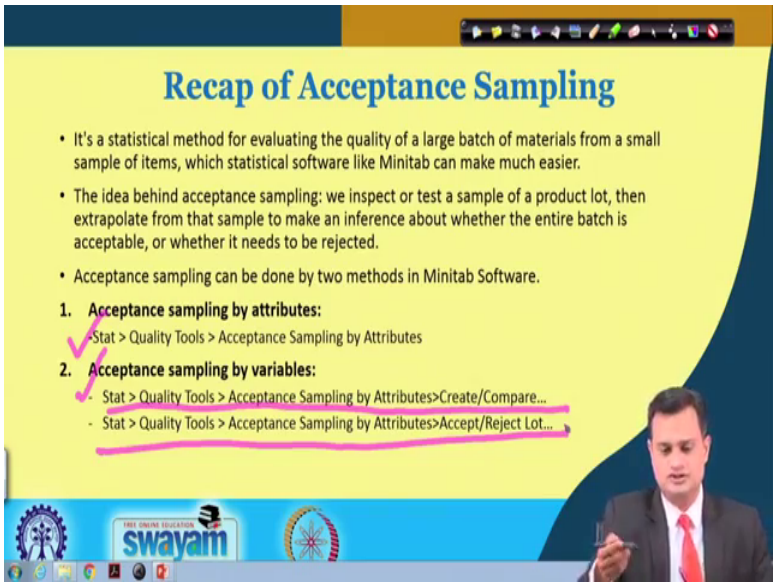

So, now it is a statistical method for evaluating the quality of large batches we know and we are ready to accept alpha and beta, because ultimately it is a sampling probability based acceptance or rejections of the lot. And typically the idea is that we inspect or test sample of a product and then, exploit or extrapolate from that sample to make an inference about the quality of the entire lot.

So, we are doing it in order to be economical in our process of inspecting and making the decision about acceptance or rejection. So, you have acceptance sampling plan for attributes and you can easily say go into the Minitab menu stat quality tools acceptance sampling by attribute, you have acceptance sampling by variable you can use stat quality tool acceptance sampling by attribute create compare or stat acceptance sampling by attribute accept reject lot. So, these are the variety you can use in your Minitab.

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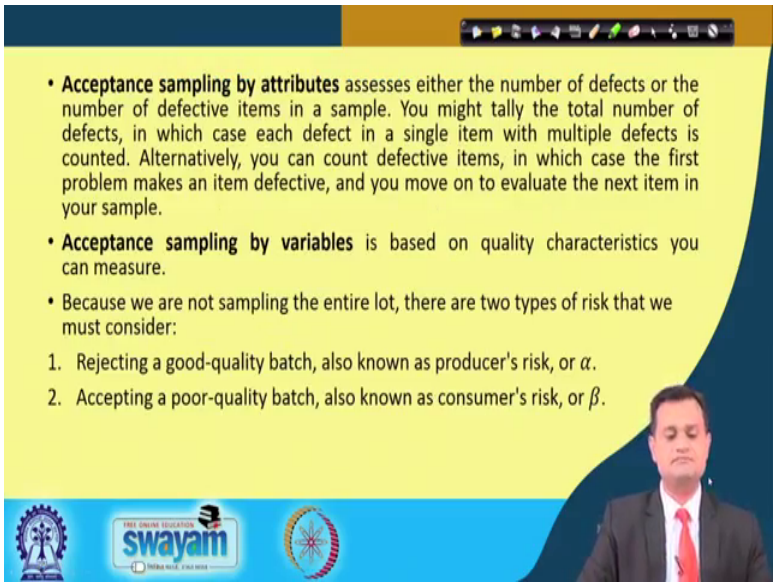

So, acceptance sampling by attribute we know what it is that assesses either the number of defects or the number of defective items in a sample is beyond a particular acceptable, limit or acceptance number or not. And when you talk about the variable you basically focus on a particular quality characteristic exact measurement and for a given level of alpha and beta you try to make the decision.

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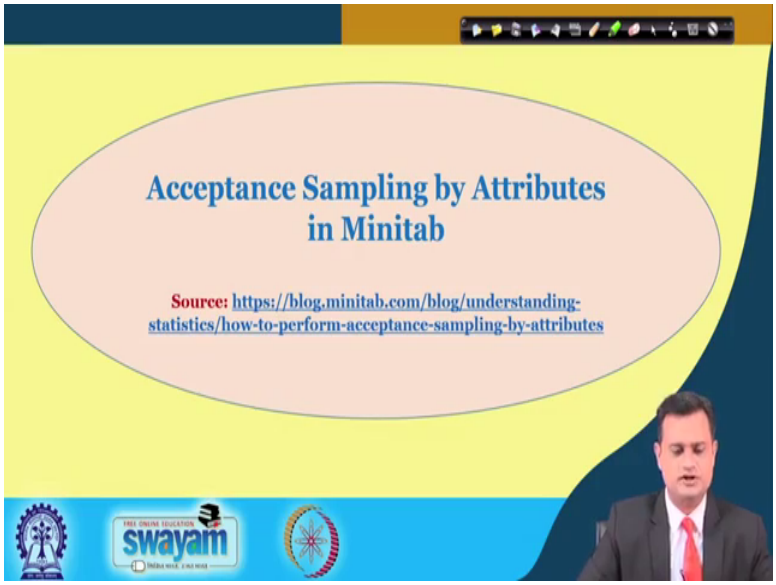

Now you can also use this particular source link available on YouTube, for going through this application of Minitab. Here I will also try to explain in detail how you can use the Minitab for conducting the acceptance sampling by attributes for Minitab?

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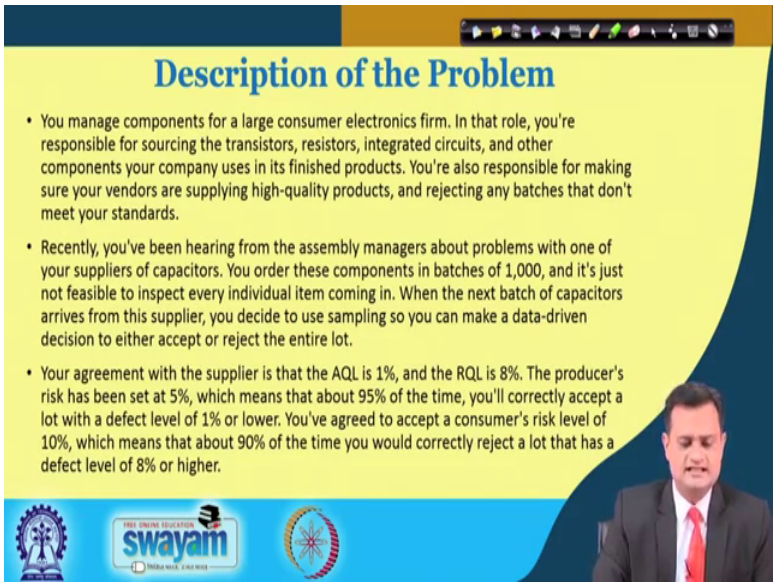

So, let us say you have a problem like this, that you manage components for a large consumer electronic form and typically you are say responsible for sourcing the transistors resistors integrated circuits and other components. Your company uses in the finished product. So, you are purchasing from different vendors the components which are used in the finished products, you are also responsible for making say sure your vendors are supplying high quality products and rejecting any batch that do not meet your standard. Now recently you have been hearing from assembly manager, typically if there is some problem in component you are downstream operations they will definitely complain.

So, you are assembly manager reported about the problem and with one of your supplier of capacitor you order these components in a batch of 1000 and it is just not feasible to inspect every individual item, so obviously, you have to go for the sampling. When the next batch of capacitor arrives from the supplier you decide to use sampling. So, that you can make a data driven fact based say decision regarding accept or reject. So, you encountered a problem, now you are interested in devising a sampling plan. So, your agreement with the supplier is that AQL is 1 percent, the RQL or you can say LQL is 8

percent; the producers risk has been set at 5 percent that is my alpha. And which means that ninety 95 of the time you will correctly accept a lot, which has a defect AQL one percent or less.

So, AQL is one of the point right indicates that the good quality lot with 1 percent or less must be accepted for 95 percent of the time, that is 1 minus alpha percent. Now you have agreed to accept the consumer risk level of 10 percent, which means 90 percent of the time you are RQL or LQL is 8 percent 90 percent of the time you would correctly reject a lot that has defect level 8 percent or higher. So, this is the situation and the idea is very clear that I want to devise a plan.

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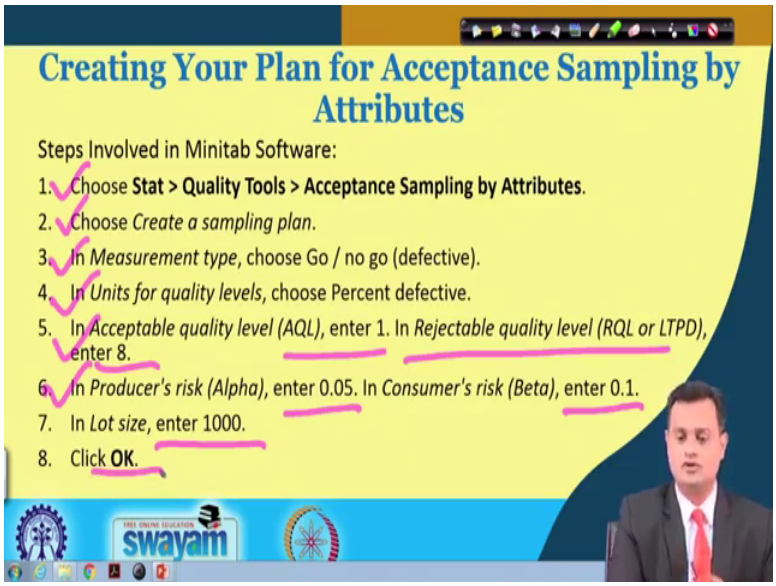

So, you go to stat quality tool acceptance sampling by attribute, choose create a sampling plan in measurement type choose go no go defective, in unit of quality level choose percent defective. You have to define the AQL acceptable quality level and rejectable quality level enter 8 because it is 8 AQL is 1. So, you enter one in producers risk you enter 0.5 beta is 10 percent. So, it is 0.1 lot size is 1000 and then you click ok.

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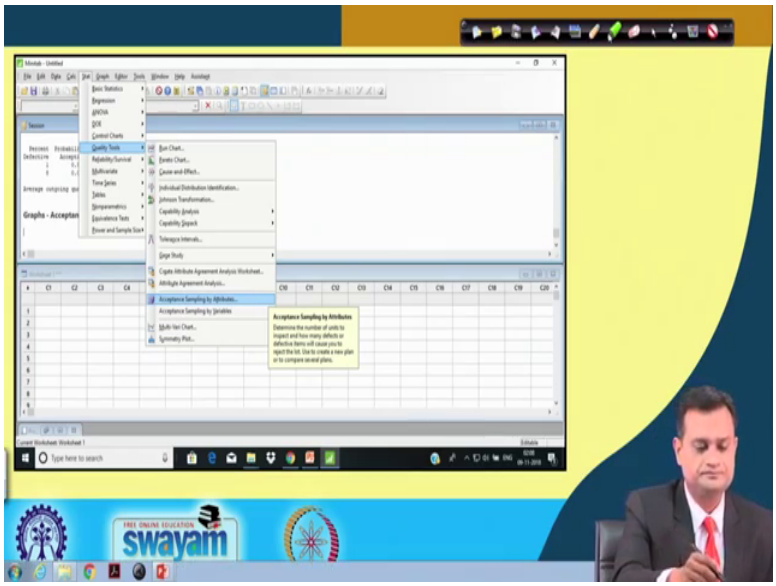

So, it goes like this, that you go to stat you go to quality tools you go to acceptance sampling by attribute here you can also see the acceptance sampling by variables; that another option is also available. So now, you go to this attribute here and you have this worksheet available like Excel, you can import the data or you can enter the data in your Minitab project new project.

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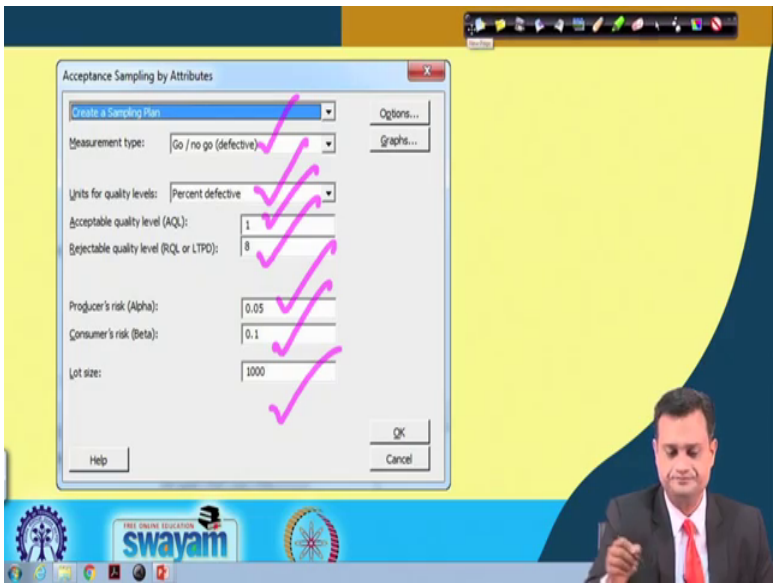

Now, you define the go no go defective, because it is attribute type percent defective quality level AQL, RQL alpha beta lot size very simple, all the data is with you and you are entering so then you press ok.

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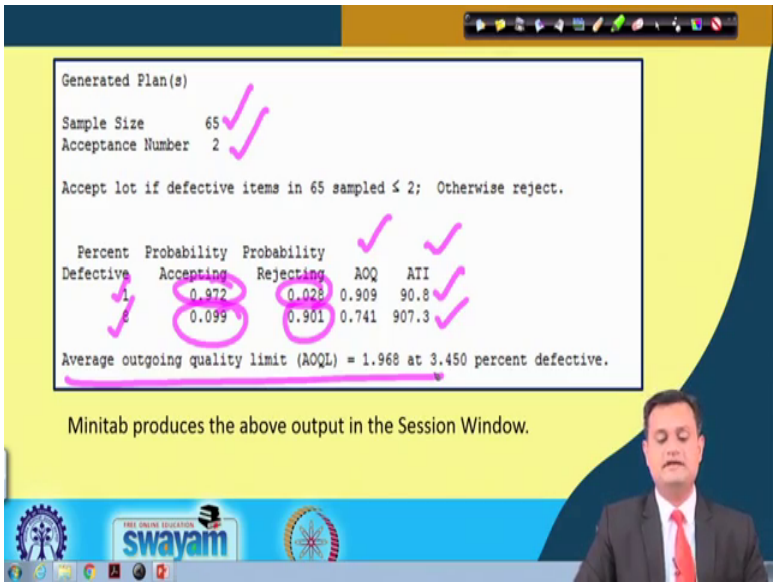

And once you do this, you will get this window result window what do you see here your sample size is 65 acceptance number is 2. It based on the inbuilt say computation available in your Minitab and the data you have provided this will come out and you have percent defective 1, 8.

So, probability of acceptance is 0.972, 0.099 probability of rejecting is just 1 minus this same way one minus this AOQ is this. And average total inspection is 90.8, 907.8. So, here what you get average outgoing quality limit is 1.968 and this is at 3.45 defect percent defective.

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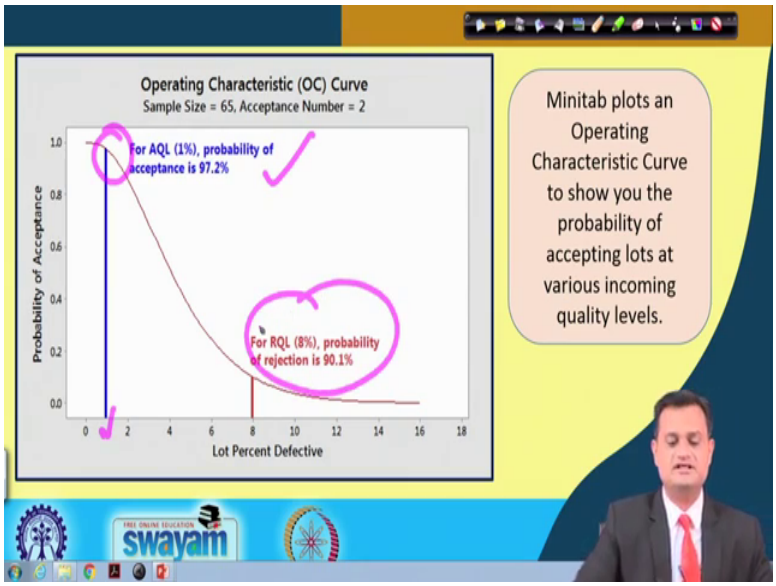

So, you need not to put any value in the formula, this will give you very easily. So, you can see here that this is my typically AQL for 1 percent probability of acceptance is 97.2 percent RQL is 8 percent and rejection probability is 90.1 percent. So, this is my typical OC Curve that your Minitab will plot.

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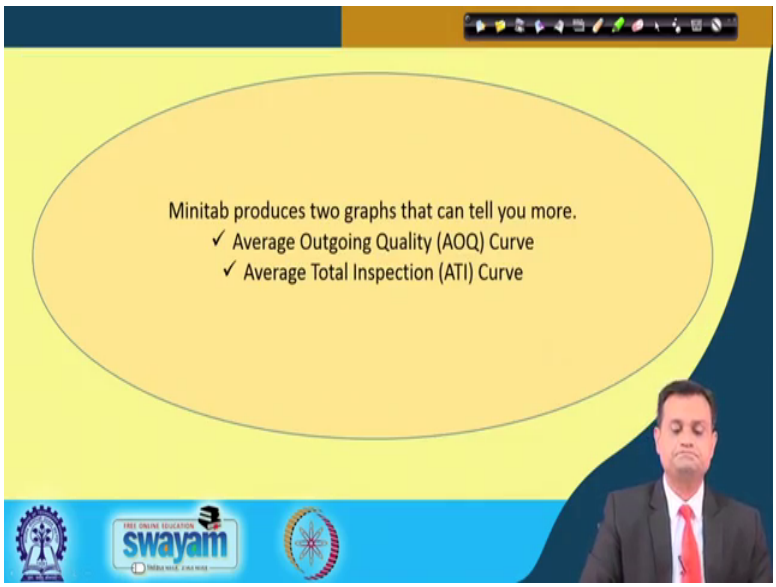

And Minitab will produce the two graphs; one is average outgoing quality curve other is average total inspection.

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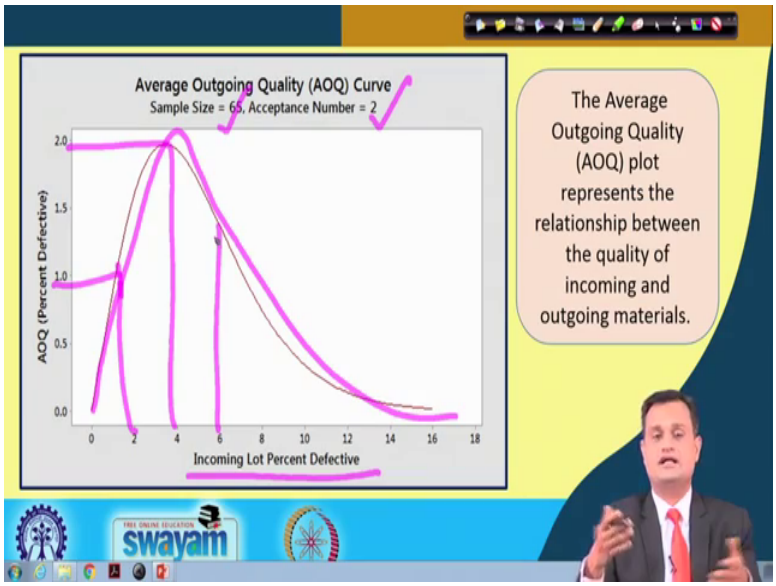

So, you can see here that sample size 65 in acceptance number 2, you have average outgoing quality curve like this. So, how will you use this? You will say that if incoming lot percent defective is, let us say 2 then this is my average outgoing quality percent defective. If it is 4 it reaches to the maximum and then after you will apply the rectification plan and further it will go down, but this will help you to understand that up to what level of incoming lot percent defective?

What is that average outgoing quality? It means it will come into your say assembly, it will come into your planned. And, if you are not say comfortable with this, then you need to agree on different AOQ your RQL or LQL alpha beta values and devise a new sampling plan or you can increase the sample size also.

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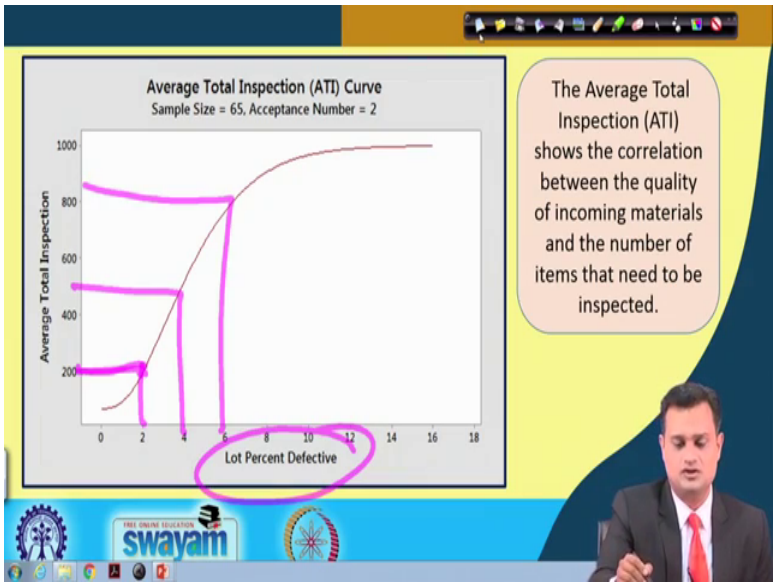

So, this is what we have studied this is average total inspection with the lot percent defective is 2, your average total inspection is very less this if it is 4 it increases if it is 6 you see. So, you are inspection cost will increase maybe after 4 it is really increasing very high and this again needs to be considered for the economical aspects of executing the sampling plan.

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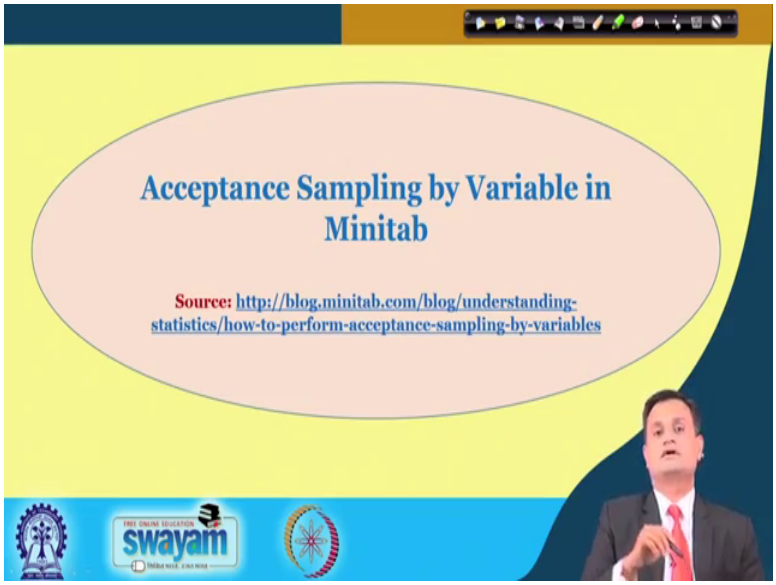

Now acceptance sampling by variable in the Minitab you can also refer this link, in order to strengthen your understanding.

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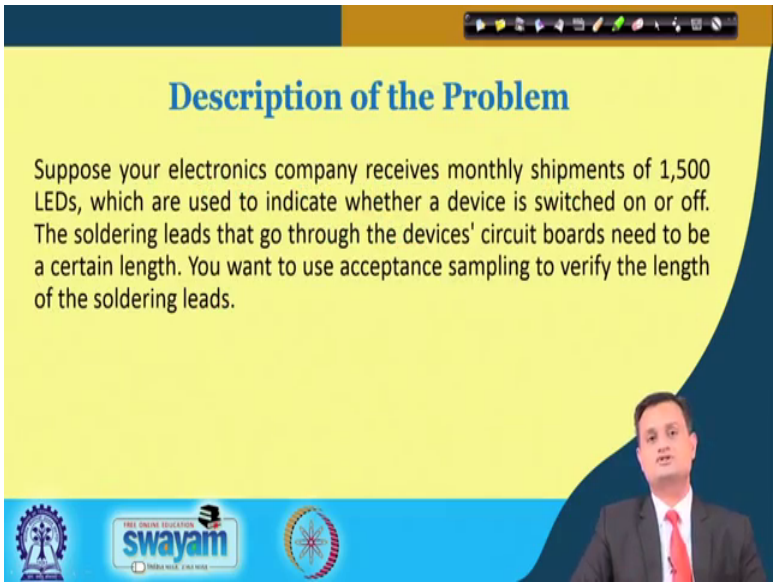

The description of the problem is like this, suppose your electronic company receives monthly shipment of 1500 LEDs which are used to indicate whether a device is switched on or off. The soldering leads that go through the device circuit boards need to be of a certain length. You want to use the acceptance sampling to verify the length of the soldering leads.

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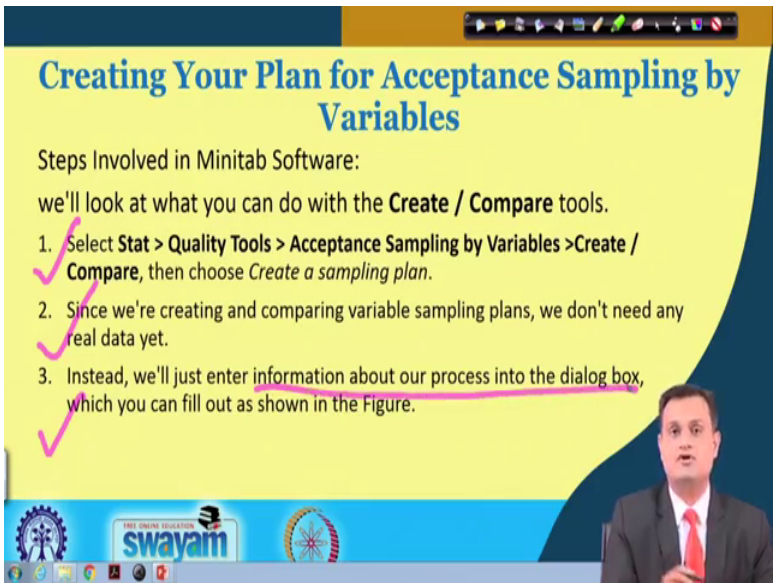

So, now the procedure you follow you go to stat quality tool acceptance sampling by variable create compare. And since we are creating and comparing variable sampling

plan we do not need any real data yet. An instead we will just enter the information about our process into the dialogue box.

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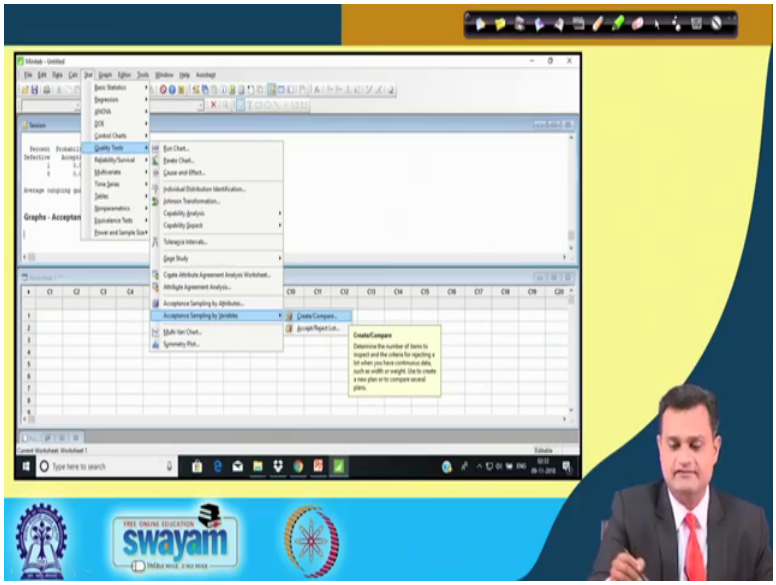

So, you can see here that I will go to quality control; I will go to acceptance sampling by variable I will go to create compare

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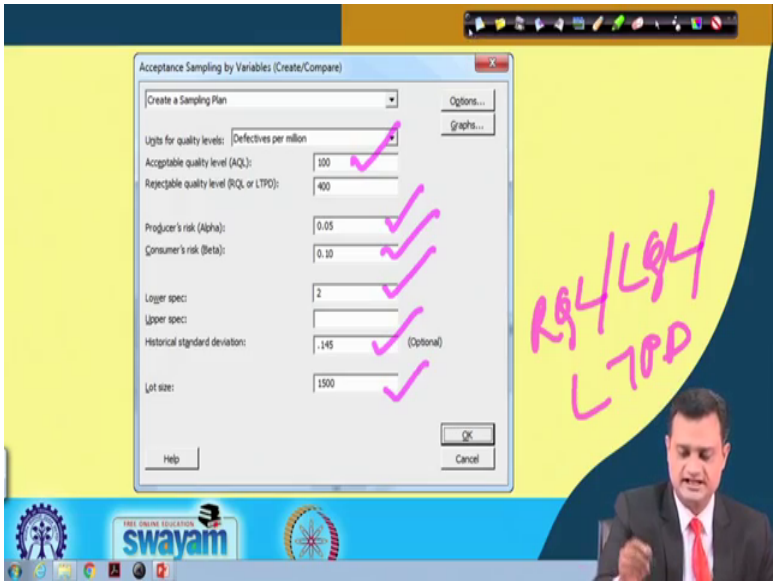

And, then I will specify all these acceptable quality level 100 RQL or LTPD or LQL, so, RQL or LQL or LTPD.

These are the various names which basically defines, they beta probability consumers risk of accepting the poor quality lots. So, you define this you define this you have the lower specification limit, you have the standard deviation based on the historical data and you have the lot size.

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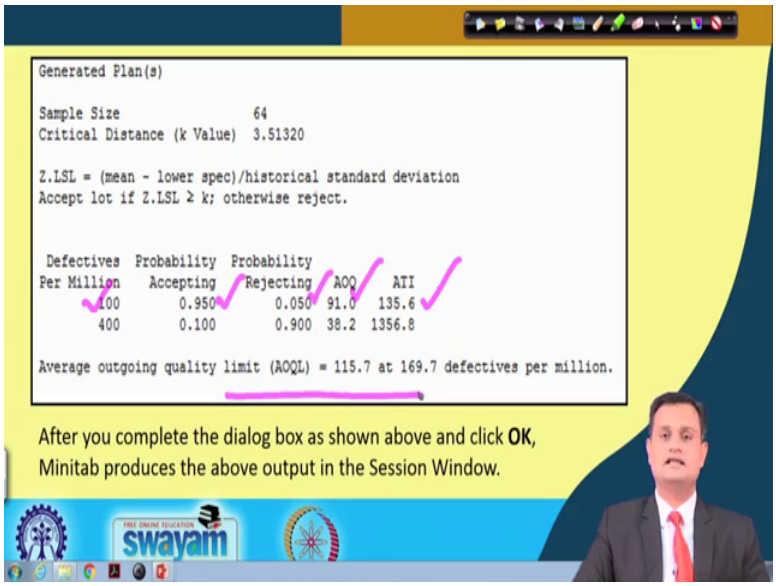

So, all these data are available to you then you press you get this window. So, defective per million 100 what is the probability this is 0.95, probability of rejecting is just 1.95 your average outgoing quality is 91 average total inspection will be 135. And your AOQL limit that is the maximum say poor quality lot that can enter into the system is 115.7.

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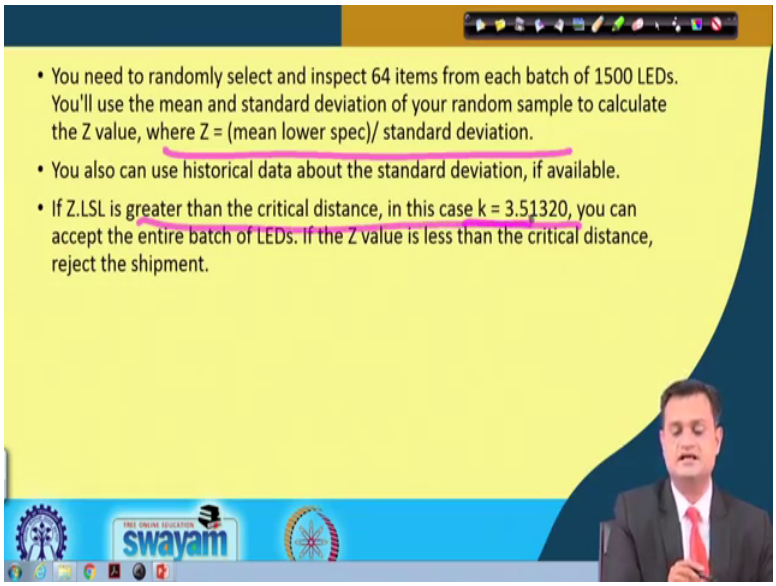

So, with this you can also define the Z, mean lower specification divided by standard deviation we have seen this thing and Z LSL is greater than the critical distance in case, 3.51 you can accept the entire batch or you can reject the shipment.

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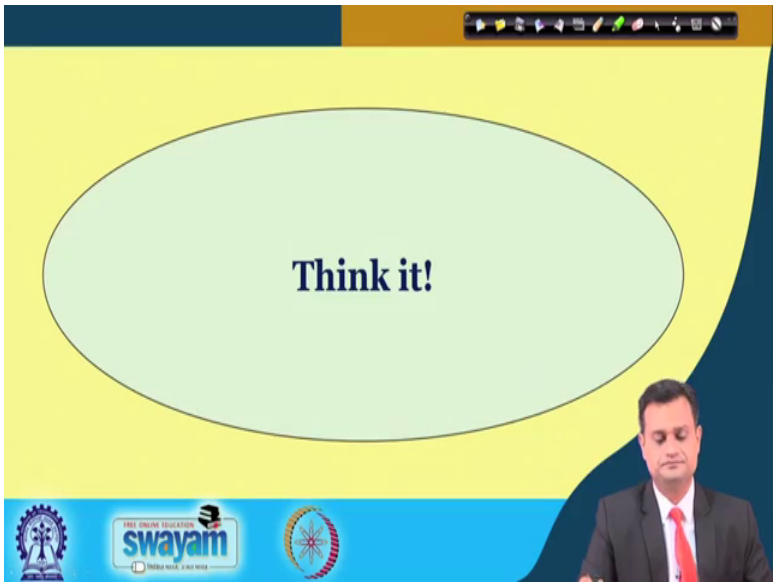

So, we have the decision rule that you can apply.

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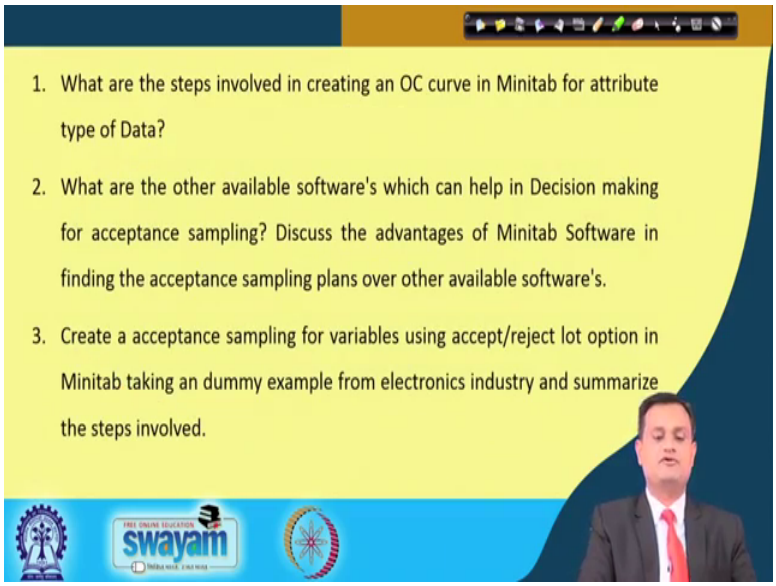

Now before we end just let me float, some think it that what are the steps you would like to follow for developing the OC curve in Minitab? What are the other available software which can help in decision making? Based on acceptance sampling and create as acceptance sampling plan for variables using accept reject lot option in Minitab and dummy example you can take or hypothetical data and just try to have hands on exercise in the Minitab.

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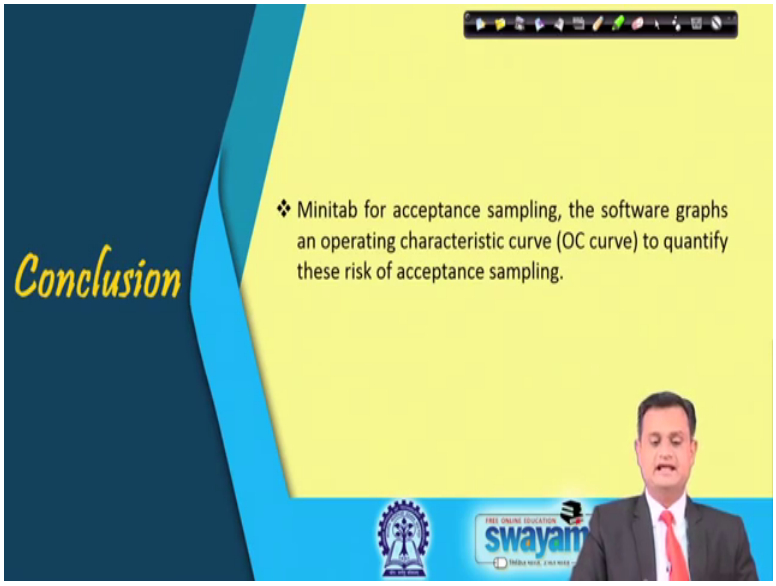

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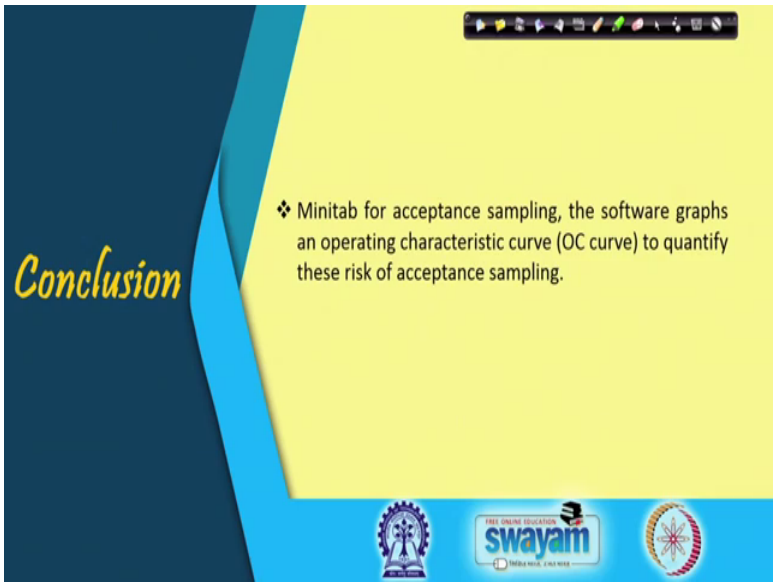

So, I hope the idea is clear how to use the Minitab for conducting the acceptance sampling developing the OC curve; thank you very much for your interest in learning the Minitab application for conducting, acceptance sampling in the software. And this can really help you to spare more time on the detailed interpretation rather than say struggling with the manual calculation. So, keep revising the concepts and solve couple of examples to have better hands on.

Thank you very much, be with me enjoy.