Design For Quality, Manufacturing and Assembly
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Lecture – 07
Types of QLF and SN ratio

But if you do not have a loss function, quadratic loss function is a good place to start.

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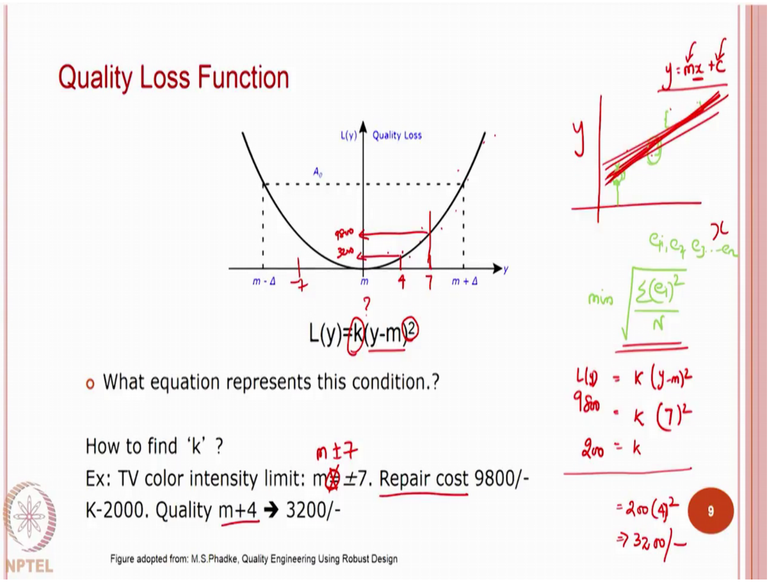

Now, the question is, this is fine, this quadratic is taken care by this particular term y minus m the square, but how do you decide the k, because that k will again influence, if I have a k of let us say 2 and this y minus m is 3 units. And; so, 3 times, 3 raise to 2 is 9. 9 times 2 is 18 instead, if I made the k to be 3, then completely 27 and since. So, this k plays an important role, how do you decide on the k? It us just a parameter estimation, if I have a, set of points that looks like it follows a linear trend, what is the form of the equation y equal to m x plus c. The only difference between this and this is let us not worry about this c for now, this is just x in our case, we are doing x squared.

And still in this case also you will have to find this coefficient; you will have to find this coefficient. It is only a coefficient finding problem do not, do not directly relate that m to the same, they are different ok, since you are used to this in general. I am using this function here. So, you need to find this m, how will you find this m? You can now, the slope is a general term that you use, but it can be extended to n dimensions also. So, so basically you do a minimum least square formulation and then you can find this m in a similar fashion, you need to or you we use a word called fitting curve, fitting.

So, if you do a curve fitting then you will find the k, what will be the motivation for that curve fitting is the errors should be minimal. Meaning after I fit this curve ok at this point, if you take this particular point that we are talking about, if you are talking about n, you see this arrow head that is what is my original value, but if I use this curve to predict it, I am getting the cross. So, there is a small error between the two.

So, I will have an error here, I will have an error here, I will have an error here. So, like this I have multiple errors, the moment you have multiple things. What you do? You take an arms, because I need 1 metric, I will not ask you hey, can you tell me how accurate the curve is here, I will ask you how good is the curve. So, you need to give me one metric. So, when you have multiple spots you will do an r m s. So, what you do is you do an r m s of these errors. So, you say error 1, error 2, error 3, up to error n, then you take an r m s of this guys, it is the same story error can be positive or negative.

So, I say squared, I make us sum it take an r m s and then I do this, then what I might want to do is, is I might want to minimize this error ok. I want to find a best fit curve, because I can have a curve that passes like this that passes like this, that passes like this, that any number of curves, but which one will I select, I will select one that will minimize this error. So, that is why it is called a minimum least squared, you find the least squared error.

So, the curve will not pass through all the points, but the trade off in the error is minimal in the best fit line in a similar fashion, this is, this is a small digression to what we are discussing. But, in a similar fashion if you do an optimization problem formulation, you will find an m, you will change the m and c and, because the moment you change your m and c these, this tilt will change each line is described by m and c, different m and c.

So, you will find the combination of m and c for which this error is less in a similar fashion, you can also do for a quadratic function. So, let us say that I had a bunch of data here, and then I have to fit this line, then I can find out what my losses are. So, you cannot just say it is quadratic is good that is good enough information, but then you need data points to begin with to define this k ok, if it is a new product ok. So, there is a simple problem, not a problem, it is just an example to motivate this discussion right. How to find the k? Now, take a color TV it is similar to our t example that we discussed.

So, the intensity is measured by some pixels. So, let us imagine that the, the nominal value for that is m ok. So, it can go plus or minus there are n number of TV's that are manufactured, not all the pixel, color representations are the same ok, there can be. So, if the value varies between plus or minus 7. Let us say, this is plus seven and this is minus 7, what I will do is I will go and find out, what the loss values and it turns out the repair cost is 9800.

Now, can you tell me what the k, for this situation is you get a point with the deviation of 7, I have a repair cost, which means the loss is 9800. So, can you tell me what the k is? No, no, no, no, no, what is the repair cost? The repair cost is means it is the loss, it is a loss that is what I said here, it is 9800 ok, what is the loss in this equation L of y equal to 9800 L of y is equal to 9800. This is k times y minus n, the whole squared, what is y minus m? In our case it is,

Student: (Refer Time: 06:48).

It is 7. So, 7 square time k. So, this is 49. So, k is going to be 200 ok. So, this is the reverse calculation, but when you want to construct the curve, you will have samples and then you will find your k, ok. Now, let us go back, just in case, with this k can you tell me what will be the loss? At an m equals 4, it is 3200 rupees that is 200 is the k value my deviation is 4 raise to 2 is 16. So, 16 times 200 is 3200 ok. So, 3200 rupees is what the losses, do you understand. So, if 1 second, 1 second; so, this is 4 then my loss is 3200. This is 9800 yeah; it is not on to scale. I am just giving yeah, what is that a question.

Student: Y is equal to 4 (Refer Time: 08:19).

Sorry.

Student: Is not y is equal to 4 (Refer Time: 08:22).

No, no y minus m is 4 y minus m is equal to 4 ok. I know where you are asking that question, this is not equal to, there was an error, it is not equal to they, they change the slide, but it is not equal to it is m plus or minus 7 is what the deviations ok. Now, I got the point, I will, I will change that here it is not. You see here, that is a correct one m plus 4, this is not m equal to, this is m plus or minus 7 sorry, thanks for the information ok.

So, it is m plus 7 minus 7 anywhere, I will get the same error, but that need not be the case, this is called the nominal. The best meaning nominal is this, if you go less if you go more, I have a problem, you need to go in this, that is all, . So, you get the point right. So, there is a quality, what we discussed in the quality is I promise you expect the moment. There is deviation from what I promised in terms of performance or of what you expected then both sides are going to have a loss. So, there is a disappointment and quantifying, the disappointment is what the loss function is. So, you can say the disappointment could be anything right for instance, if you are talking about, ok. It is always not disappointment; disappointment is just a word that I am using to get the message across for instance, if you are talking about a, nuclear power plant ok.

So, there is a small deviation sir, there is about 1 unit radiation leak, you think it is. It is not ok, you have to shut down that entire plant, if there is a radiation or whatever that product is you have to cut down on that project immediately ok, you cannot offer to do that ok. So, whereas, you buy a 5 rupee pen and then the manufacturer figures out in that particular series ok. There is some writing issue ok, they are not going to have a recall, it is ok. It is not a big deal, they are not going to have a recall, but if you are a car manufacturer and your airbags have a problem, you figured out after 3 months of selling, you figured out that the particular series the airbags will not open up the correct way, you have to have a recall ok.

So, the loss function is not the same for all of them meaning the, the k for the loss function is not necessarily, the same for all of them ok. It is not necessarily, but it is not the same, it depends on the application and depends on what the consequences are you get the idea right ok. So, are there different loss functions ok, yes. So, for instance this is nominal.

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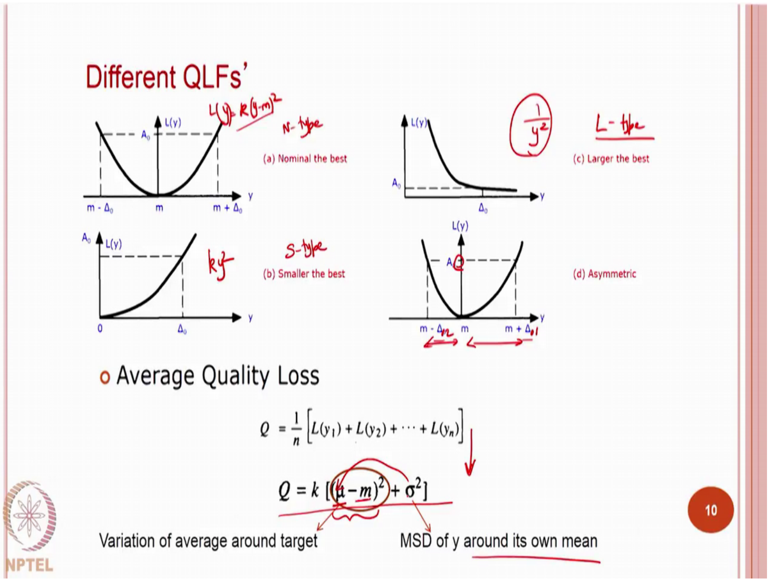

The best that is what we discussed just now, right our t example ok. So, it means I have a nominal value, I go plus or I go minus there is a problem. So, for instance, our washer or any manufacturing you will have this nominal the best. So, I want 5 mm, I can accommodate 4.8 or I can accommodate 5.2 ok. So, it is this way or that way it is just nominal the best. So, you can take smaller the best ok. So, can you give an example of smaller the best; class timings smaller the better ok.

We do not want 15 minutes can you have like 20 minute class can you have 10 minutes class I will be happy ok. So, smaller the better any example, any other example of smaller the better, when you have a flight change, change over your layover time smaller the better; so, any other example, any other example of smaller the better.

Student: (Refer Time: 12:34).

Sorry.

Student: (Refer Time: 12:37).

What fluctuation?

Student: (Refer Time: 12:44).

Daily fluctuations in Bitcoin ok, that is a kind of the most recent case ok. So, that is one thing then radiations from your cell phone or computer or any media device, you want to keep it as minimal as possible see you do not want to get rid of it you cannot say oh, you cannot use a cell phone, you cannot use a computer. Now, we all know that there is no life without these media devices so, but as a manufacturer or as a user you expect the radiations to be as less as possible. So, smaller the better in this case right.

So, you understand the curve do you. So, there is no what, what it says is the smaller the deviation is the better, the loss is 0 ok. The moment your deviation goes this side, because after this I mean, this is a limit, because it is normalized to 0, but if this is not normalized, I can go beyond this also, but then it is smaller. So, how much ever smaller, it is the better it is, but you cannot get beyond this, it is 0 that is all, that is the best, you can have.

So, the moment you start deviating from it on the right side or on the positive side, on the more side then the loss is also going to be large. So, this is smaller the better, larger the best or larger the better is here. So, this is the other side of the curve if you look at it ok. So, what it says is I am going on the right side, which means the deviation is larger ok, the deviation is larger and my loss is less you understand right. So, I say that here is a value and then I am going away from that when I am going away from that the more the deviation is the better, it is for me ok. So, can you imagine a case like that?

Student: (Refer Time: 14:32).

Sorry.

Student: (Refer Time: 14:33).

Return on investment any example, you take 50 kilometers per liter 55 kilo, I am going to give, I am going to develop an engine that will give you 80 kilo meters per litter larger the better ok. What is the salary larger, the better return on investment same time. I will go 8 hours to office for 5 days 40 hours, but that job pays me 10000 rupees and this jobs weighs me only 50000 rupees. So, that is a better larger, the better, imagining that the profile of the jobs are same ok.

So, this is larger the better ok. So, that is an example in this case. So, return on investment that is a very good phrase that we used in, any way in example the investment is the same, but your return, asymmetric ok. It may not be always symmetric ok, when you go more ok, when you deviate more on the positive side, your loss could be large or less compared to your, deviation on the other side.

So, these are the different types of, loss functions that are possible and there are different, see for instance, this guy, we saw that it is y equal to k times or sorry, this is loss of y equal to y minus m, the whole squared right. Can you tell me what could this function be, the smaller the best, but please understand that in all these case the functions are all quadratic in nature, but as I told you, this is a general proposal, but depending on the problem application, you can have any exponential can have linear.

Student: (Refer Time: 16:29).

Sorry mod of, mod of.

Student: k (Refer Time: 16:32).

Mod of k, you mean the absolute value of k k is just a constant right.

Student: k to be greater than (Refer Time: 16:41).

Oh, you mean like that ok. So, ok so, let us say that k is greater than or equal to 0 then

Student: (Refer Time: 16:50).

It is pretty much the same, any other comment on that.

Student: (Refer Time: 17:01).

Why? Why; y minus same it could be just y squared at least the way that I have drawn the graph, it, he says that from the way, the graph is present, it because here, it is m and it is m plus or minus. So, I use a word, I use a term y minus m, but in this case it is 0, 0 is the best that you can have it cannot go less than that and then I am having y. So, it is actually y minus m, but the m in this case is 0. So, he says k y square that is, that is fine, I mean what you are telling is also correct, k is greater than thing. It should be y minus m, but m in this case is 0, that is all ok. So, this is fine, what about larger the better.

Student: (Refer Time: 17:50).

Sorry.

Student: (Refer Time: 17:53) reciprocal of smaller (Refer Time: 17:56).

Reciprocal of.

Student: (Refer Time: 17:59) the smaller the best.

The smaller the best, correct. I will just, I will just say 1 over y square, it can be k times 1 over y square does not matter 1 over k, because it is just a constant in it any day, anyway ok. So, this is just a reciprocal of 1 over y squared, but there are also other ways in which, you can represent it, this is not the only way that you can represent it ok.

So, there is a nice intuitive feeling in this, I like the way, he told, he said that it is a inverse of smaller the better smaller, the best or smaller the better. So, these are usually called n type nominal the better this is called S type. It is a yeah just remember, you know, you do not really need to memorize this but, sometimes people, people you know, miss remember they say n type means lower the better. There is no lower, it is only smaller, the better, you will have to be careful when I describe it, I might write it as L type, but L means larger the better, but if you recall it as lesser, the better than it is con ok.

So, it is only smaller larger nominal and then of course, there is an a symmetric, a symmetric depending on what you are looking at this. It is, it is again k y minus m the whole squared, but on the other side, this k might be different. So, this is k 1 y minus m the whole square, this is k 2 y minus n the whole square that is all. So, that k will influence the shape, it is still a quadratic function, but that k will tell you how steep it is or how shallow it is, fine. So, now, as we discussed, you have a question yeah.

Student: (Refer Time: 19:51).

oh so, you mean to say that this delta naught.

Student: Yeah.

Yeah, this delta not is not necessarily the yeah, from the y axis meaning the, the x axis, which is the y here from that axis perspective. It is not the same distance wise, it is not the same yeah, you are right the idea, I guess here is for the same loss, you have different, that is the point. In this case, if you take for a naught, the deviation is the same.

In this particular example, if you see for the same, a naught, the deviations are the same whether you are in the negative order, you are in the positive side your, your point is valid, this cannot be delta naught, if this is delta naught, this is delta 1 and this is delta 2, something of that sort the delta is not the same that is all.

Student: If it is symmetry then it will be (Refer Time: 20:54).

Yes, you are right ok, any other question I mean of course; we are going to discuss about the average quality loss, but before that any other questions. So, just before this discussion, we had a discussion about our 6 sigma and 4.5 sigma, you might remember right. So, the deal is in that if you see your loss is not going to be the same, if you take one distribution per day, the loss is not going to be the same ok. So, I might have a loss of y 1 and y 2, meaning like y 1 y 2 y 3 like that I have different losses here.

So, what is the average quality loss correct the moment you have more than 1 ok, if someone is asking for the performance, I need to take the average performance of the class. I can only tell the average height of the class in a similar fashion when your loss is not the same. So, please remember that engine number 1 and engine number 7, you can hope that they will perform the same, but they need not perform the same.

They are not likely to perform the same, I have 60 students in the class, all of you are going to sit for placements, but the company which is going to come and interview, you cannot expect all of you to perform to the same level. Of course, there will be a minimal and a maximum level that they expect you to perform, but all of you will not perform to the same level ok, there will be variability right.

So, in a similar fashion; so, the first car model might have a loss of this, the seventh car model might have a, of this seventh car of on the model ok. So, if you want to understand the average loss of the entire fleet then I have to add all of them right. So, loss of y 1 plus loss of y 2 plus loss of y n; so, there are n instances then I will have to add up all the losses and then I have to take a me. So, this is something that you can try to do as an exercise, after you do a couple of algebraic steps, because we know the, L here, from here you know the L right. So, the L is k y minus m square. So, you can plug in those values here for y 1 y 2 y n and you do a couple of algebraic steps, what you will end up getting is you will end up getting this equation.

So, please remember you can take the, nominal the better case, the k is going to remain the same. So, this k can be taken out, but you will have that y minus m is going to vary m will remain the same. It will be y 1 minus m the whole square plus y 2 minus m the whole squared plus y 3 minus m, those quite plus y n minus m, the whole square. It is a very simple step couple of steps, you do, you will end up with this equation.

So, what does this equation say? There are two quantities in this equation that you are already exposed to. So, one is the mean mu and the other one is the standard deviation. So, what it says is the quality loss consists of two terms, the first one is the variation of the average around the target, we will see what it means, the mean square deviation of the y around its own mean ok. So, there are two things here. So, one is, there is a target that is given, what is the target 50 kilometers per liter in the motorbike that you bought, that is a target, but on day 1 you take 48 kilometers per liter, on day 2, 49 kilometers per liter, on day 3, 45 kilometers per liter, on day 4, 52 kilometers per liter.

So, there is variability in the performance, but you can also after 1 month, if I ask you what was the performance of your motorbike, you are not going to say me on day 1, it was 48, on day 2, it was 49. What you are going to say on an average, I had a, mean value of about 48 kilometers per liter. So, that is this one that target is the 50 kilometers per liter that I promised you and this mu is the average that you got over a period of 1 month.

So, the first one is the difference between these two guys and it is the square of that then did you get, because I always told you taking the mean is only one part of the story, when a batsman comes in, if I give you only the average, it tells you only one part of the story ok. You also need to know; what was the deviation. You need to know, what is the spread and what this spread, this sigma tells you is, what was the worst, what was the best that you got oh, did you get 54 kilometers per liter; that means, this engine is capable of going to 54 kilometers per liter, you got 35 kilometers per liter that was pretty bad ok.

So, this sigma, what it says is the sigma around the performance of your engine, not the promise that I made. This sigma is related to this mu, that is what it says around, it is own mean, you got 48 kilometers per liter, that is the mean that you got over one month period, but what was the deviation in that was, it 2 kilometers or was it 5 kilometer deviation that is this information ok. So, the quality loss function, the average quality loss is k times, this squared plus that standard deviation ok. So, as you can see the units will turn out to be the units will work out ok. So, if you do this, there are a couple of steps, which I expect you to do you will arrive at this value. So, this is one way of looking at it.

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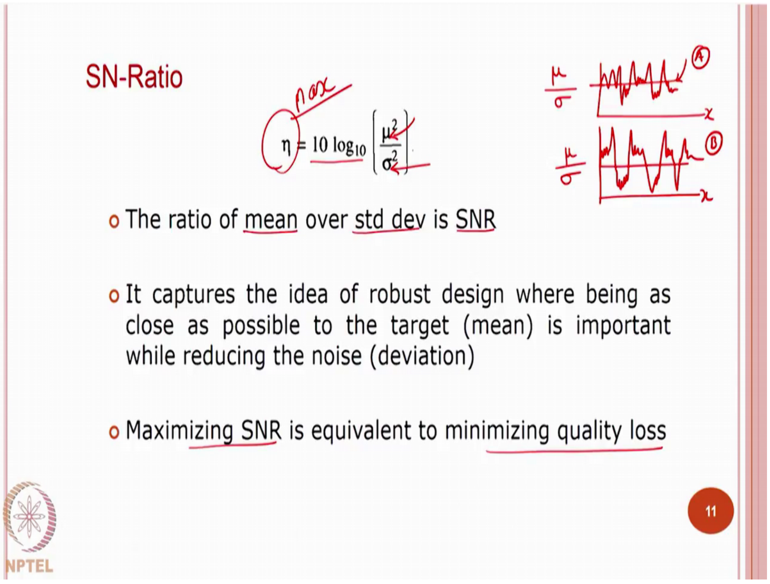

The other way of looking at it is called the SN ratio. So, the S N stands for, signal S stands for signal, N stands for noise ok. This comes from electrical background and this was proposed to by Taguchi. Since, Taguchi, if you remember that I told was an electrical engineer and for whatever reason he was recruited to, apply his techniques on the manufacturing industry; so, that they wanted quality products basically, electronic products that they wanted to do. So, what he did is he used this idea from electrical engineering ok. So, in electrical engineering if you see, any electrical stuff that you take is represent into using signals any, any electrical stuff right. So, they always wanted to compare signals ok. So, this is case A and this is case B ok.

So, the idea about electrical signals is, though you would like to have this you cannot have that there is always noise ok. So, very simple you have fever, you take the thermometer, you put it in your armpit or you put it in your mouth ok, you think that it is going to stay in one value, it will just keep fluctuating ok. You stand on a digital weighing machine, small chain. It will, it will keep on oscillate there, because that all these are calibrated devices in spite of that ok. That is why you use filters, Kalman filter, this filter and not all those type of filters they will let you, you know give you a single value, but in reality the signals are like this, there is always nice than that.

So, now the way in which they will compare two signals is, because the signal is not one value right. So, this is x, this is also x, the signal is not one value, this lot of values. So, immediately your point is I will take a mu, what else will I say? Around this mu, what is my noise? Any variation from my mean is, my deviation right. So, signal to noise, I will compare this signal to noise, to this signal, to noise.

So, now, there are different perspectives, this may need not work the same way in electrical, but the idea is once you have a quality that is varying or once you have a quantity that is varying. What I wanted to know is I want to know this in terms of consistency ok. Now, you can apply the same thing for a batsman ok, if you do this for Sachin Tendulkar and Sehwag for instance, that you know these examples right. The average might work out to be the same might. I do not know exactly, but it could turn out that they have a similar average ok. But the noise is more in Sehwag, because he hit up to 250, what was his highest score in 1 day.

Student: (Refer Time: 30:40).

260, 260 he has scored and I am not sure I need to look at the data, he might have had, more number of more occurrences with less cores, also compared to Sachin Tendulkar. Sachin Tendulkar might share the same average and a lesser maximum, what was his maximum 200 ok, where is that guy is 260, that is almost a teams score right. So, the noise with Sehwag is more meaning, the noise in the data, not the noise he makes right. So, the noise in the data is more with Sehwag compared to Sachin Tendulkar, but both of them could share the, for the case of example, do not take it in person ok.

For the case of example, let us say that both of them shared the same mu then what happens is I am going to do for Sehwag. I am going to have a larger noise, which means I am going to have a larger sigma, you understand right. When I am going to plot the data, Sehwag data, data has 1 to 60 whereas, for Sachin Tendulkar, it will stop at 20. So, when I am measuring the standard deviation, the deviation is more for Sehwag compared to Sachin Tendulkar assuming that their means are the same. So, Sehwag is going to have a larger deviation compared to this person.

So, if their means are same, when I am dividing it by a larger deviation, what will the S N ratio be the value in a comparative sense for Sehwag is lesser, because my denominator is larger for Sehwag compared to Sachin Tendulkar ok. So, in this case, if you are talking about a consistent player ok, you are not talking about whether this person is going to go and hit a 300, for me today, that might be the case in T 20, but if you are looking at 1 day games and especially, if you, talking about the first down or second down, you want a consistent player who will go and stabilize the game.

But if your openers did a great job then what you want to do is, is you want to send someone who has a potential of creating noise, larger noise, you might go and hit all, all sides and he might get a bigger score. So, otherwise you want to get someone who is more, who will stabilize the game then you will send someone who is more-more consistent, who has less noise. So, the S N ratio can be used the way, you want it ok. So, we will see how that is used in this case ok.

So, here this S N ratio is essentially this mu is also squared, the sigma is also squared, see sigma and mu are of the same units. We are just squaring it here and this 10 log, 10 is just a it is just a normalization value ok, see the deal is sometimes your, sigma is 0.001, if you square it, it is going to be even smaller. So, let us say your mu is even of the order of 1 or 2, it is going to give you a long, you know it is going to be a very big number ok. So, in order to normalize that we are taking a lock ok; so, you can yeah, this is just normalizing the data, this does not add much value to the information. So, this is just. So, what is S N ratios, this is your S, which is your mu this is N, which is your standard deviation that is your noise. So, the ratio of mean over standard deviation is your S N ratio.

So, it captures the idea of robust design how, because you want to be as close as possible to your mean and the deviation should be minimal. So, I need to have a minimal deviation, but I want to stay as close as possible to my mean. So, what it means, I need to have a larger or smaller S N ratio. Oh, sorry.

Student: (Refer Time: 34:30).

You want to have a larger S N ratio, because I want to minimize my noise, if I am going to minimize the denominator, my ratio will become large. So, from a design perspective I want to maximize my S N ratio ok. So, how do I formulate a problem using robustness is, if you have data points then you can estimate your S N ratio then I would like to maximize, give me a design combination that will maximize my S N ratio that will correspond to my robust design, that is what the deal is. So, maximizing S N ratio is equivalent to minimizing quality loss, is it fine.

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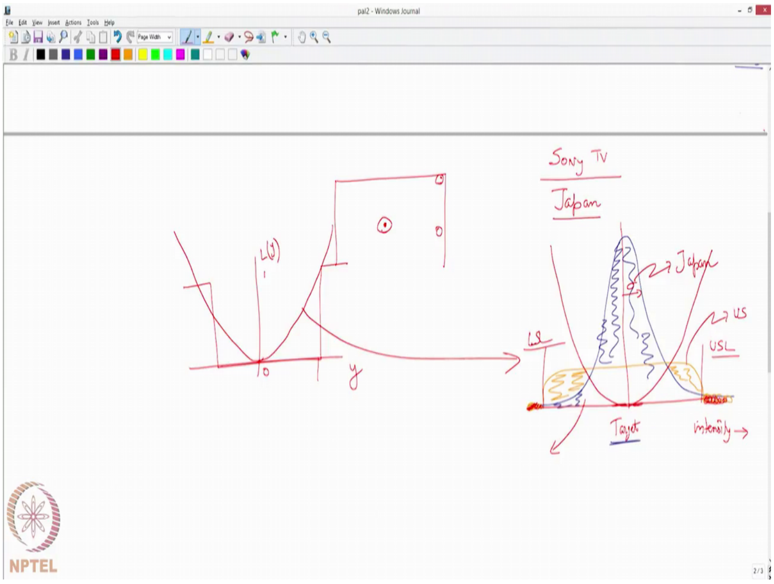

So, we are running out of time, but I will just conclude with one example ok. So, this will give you some idea ok. So, this is a classical case, which is available in the book that we discussed. So, Sony TV example; so, Sony you know, where their roots are there, from where originated in Japan ok. So, this is, this happened a few decades ago ok. So, Sony was making TV's in Japan at some point in time, people in the US were buying TV's from Japan. So, it was important in brought to Japan then I do not know maybe the government, is in the business knobs and then Sony set up a shop in, US, when I say set up a shop, they also set up a manufacturing unit.

But when they started selling the, TV's that were manufactured in the US. They realized, after a while people preferred buying the same Sony TV's from Japan though, it was expensive than buying it from the US, you get a point. Sony was selling TV's, in the US that was made, manufactured in the US, but people preferred buying it from Japan, the same model ok. They preferred buying it from Japan, though the cost was more. So, now, Sony was confused or early Sony US was confused. So, why would people buy more for the same pay more and buy the same model at a higher cost then they figured out people said that the quality ok, of the images, maybe in terms of pixels or something, the color intensity was much better in the Japanese counterpart, than the US counterpart.

So, then what Sony immediately did is, they wanted to understand what is happening. So, they took about equal number of TV's from both the Japanese side and the US side and they compared the probability distribution ok. So, what it turned out this ok. So, this is an interesting graph ok. Now, let us call this, the intensity that we are talking about ok, any idea on which curve is from which place.

Student: (Refer Time: 38:40).

Sorry, the flat one is from and this is my target actually, as a matter of fact, I should draw it even better. So, if you understood what I have told. So, far you do not need any explanation on this plot, but for the sake of completeness, I will tell you, what it was ok. What these people figured out is as you can see from the graph; there were more occurrences closer to the promise that was made ok. This is the promise that they made, the target and there were more occurrences this entire region right and as they went away, when they went away from the promise, the numbers reduced. You can see how different it is with these two guys and actually, as a matter of fact I do not know whether, this was the case with the Sony b actually, but it can be beyond there are, there were few things that were below the lower specification limit and upper specification limit.

These are the upper and lower specification limits. There are situations in the Japanese stuff I am just telling and you know this may not be the real case ok, it would have been a case where there were even products that were beyond the lower specification limit and above the upper specification limit, but still people preferred this. The reason is, because there were more occurrences closer to the target compared to these guys, in spite of day being between the lower and the upper specification limit in an uniform sense, did not help you get the point.

So, it is very important to stay as close as possible to the target, as close as possible to the, you cannot say oh, it is plus or minus. So, I will do it this way. So, this plus or minus is called the, the gold post principle ok. So, what is the goalpost principle you have a goalpost in a soccer game. So, if you are going to hit in the center, I will give you 5 points, if you are going to hit here, I will give you 2 points is that how we do does not matter you do it here or you do it here or you do it here, everywhere it is only 1 goal.

So, that is called the goalpost principle. So, the US in this example, the US TV's, the Sony TV's kind of followed that principle, they said as long as you are within the lower and upper specification limit you are fine, that is not true and the equivalent loss function for the; so, this is the x and this is your loss function right. So, y sorry ok; so, this is how it is. What it means is this is 0 and this is 1. It is a binary, it says when you vary from here to here there is no loss. The moment you cross this line, your loss is 1 ok. As you can understand what Taguchi said is that is not true your loss function goes like this, even a small deviation, there is a little bit of a loss the more the deviation, the loss is more than the loss is more, more, more, ok.

So, there is a relationship between this and this ok. So, this meaning the quality, the goalposts principle corresponds to the US stuff and this corresponds to the quadratic loss function, you get the point. So, if I am going to keep my distribution smaller and smaller my loss is going to be smaller and smaller, if I am going to have a fatter distribution my loss is going to be larger.

So, that is where the idea of using the statistical distribution in controlling robustness, comes into picture. In robustness we just said that oh, you need to minimize your sigma as much as you want around the target that you promised. But, how does it reflect in the quality loss function, this is how it reflects, because the more you deviate from your promise, the more is your loss. So, that is how it comes ok.

So, fine, I will wrap up here for today.