Evaluation of Textile Materials
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Module No.#02
Lecture No. # 06
Sampling Methods and Sample Size: Practical Statistics

Hello everyone. Our today's topic is the Practical Statistics. So we will not go in detailed of the statistics. We will confine our self here our discussions only with some practical application of statistics in Textile Industry or Textile practices.

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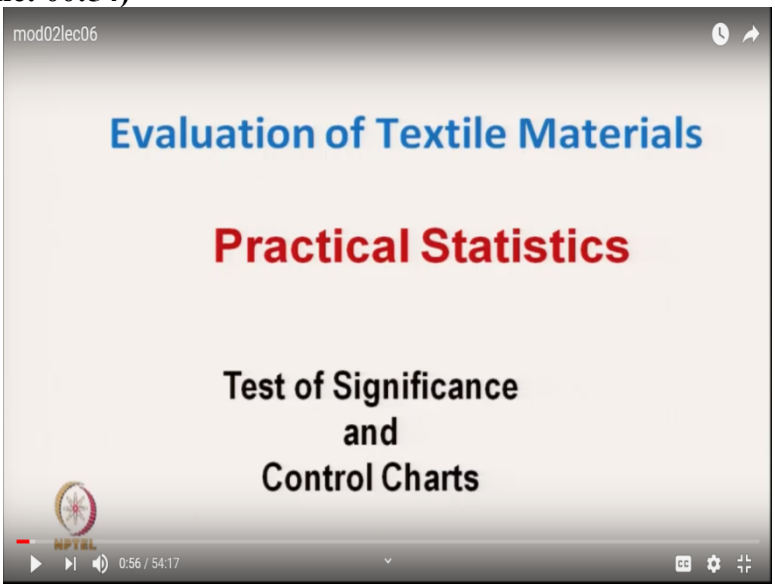

And most commonly used practical or statistical approaches are, one is test of significance and control charts. Okay. These 2 aspects will cover here.

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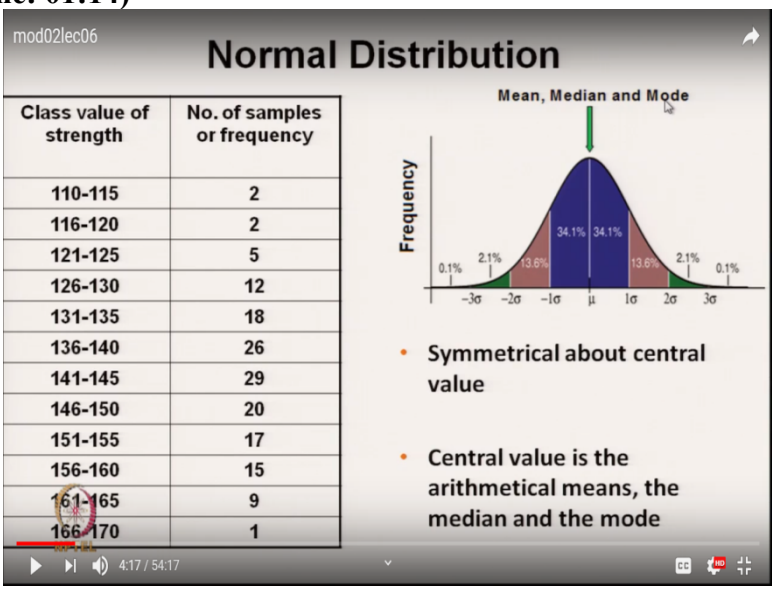

So, first let us try to understand the distribution. In Textile industry in main practice we have to handle a large number of data, large number of items we have to test. Suppose these are the

data it has been tested for strength, okay. Unit may be anything, okay. So 110 to 115, so the strength that is from 110 to 170. So, 110 to 150 so the frequency is that the number of samples we have bought. So 2, 116- 120 another 2 like that so we can form a table.

This table if we form in the form of diagram, this is the distribution and in most of the cases in textile material, as they are in random in nature. So most of the textile it has been observed the distributions or normal distributions. So, what is normal distribution? This normal distribution is that symmetrical about the central value. So, this is the central value and both the sides, it this is, these are symmetrical.

There are cases it is asymmetrical distribution, like we have discussed the length biased sampling, where, it is a skewed towards the higher side. But in our discussion we will confine our self that most of the distributions are in normal distribution. Nature what is the nature? This is at the, centre, where the central value is actually coinciding. That means this is the mean. This is the median and this is mode, mode with the maximum frequency.

So, maximum frequency is at the centre okay. If we say the number of data number of data at the left side of the line central Line and right side of the central line are almost same. That means it is becoming median and also if we take the average value, this will be the same. That is why this is in the normal distribution, the central line it is coinciding for mean, median and mode. Now we will with this assumption we will try to see what is there in the normal distribution.

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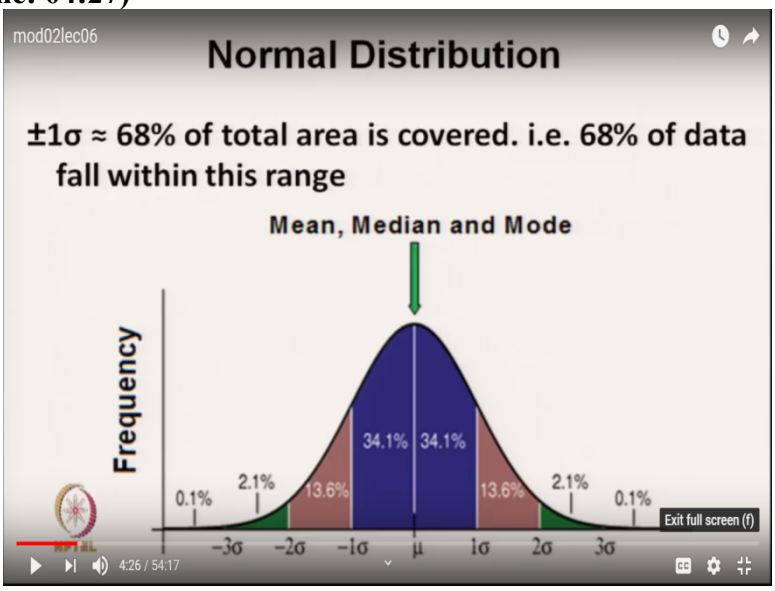

If we see this is the; that this Sigma the standard deviation and plus minus 1 Sigma what does it mean? That is mean +1 Sigma and -1Sigma. So if we see this is the mean value, it is a mu okay and +1 Sigma. If we go right side this is a plus side and then if we go to the minus side

in normal distribution typical it is around 34%. If we go in one side this is typically the 34% of the data 34% of the entire data lies on that mean +1 sigma.

And similarly -1 Sigma it is another 34%. So, if you take together it is a blue line blue zone this takes care of about approximately 68% of the data. Now if you take the larger value

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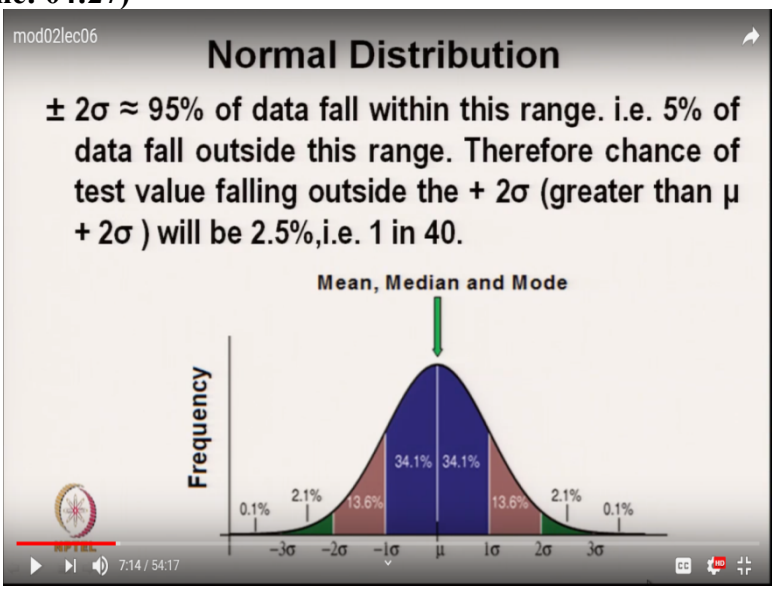

So, plus minus 2 Sigma if you see plus minus 2 Sigma, so from +1 Sigma to +2 Sigma, so +1 Sigma we will see that it is a 34% data. And +2 Sigma it has become 13.6% approximately. That is because it is going away from the mean zone. So, at the right side we are adding 13.6% and again in the left side we are adding 13 because it is equal in the both sides. So, if you take together all these +2sigma and - 2sigma it is taking care of 95% of the data.

That means here within the; if it is plus minus 2, mu plus minus2 sigma. That means 95% of the data are lying in that region. Similarly one can have plus minus3 sigma it is almost 99.9% in that way. So, if you see plus minus 2, sigma it is a 95% of the data are included in this. That means 5% of the data are above of that range. Beyond the side, so in one side it has become 2.5% approximately.

So one side it is 2.5% data it is largest side and smaller zone, it is another 2.5%. The total it has become 5% data fall outside this range. Okay. Now, so in one side it is 2.5% so what does it mean 2.5%? So that means one in every 40 data, is ranging it is larger size. That is if it takes a reading of 40 yarn count and if we assume it is a normal distribution that means one in 40 readings will be equal, will be more than mean value plus 2 of standard deviation, okay.

That is suppose the mean value is say 10, standard deviation is 1 that means 10+ 2 multiplied by 1 that is12. So, one out of 40 reading will be more than 12. Similarly one out of 40

readings will be less than 8. So, that is the concept of this, okay. And if we are talking about the plus minus 2 Sigma

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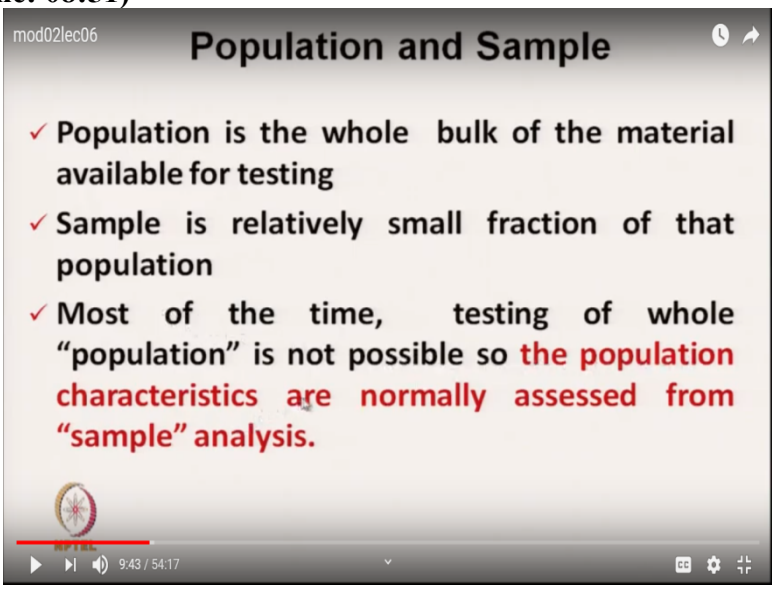

Now as we have discussed earlier also, let us see try to see once again, what is population? And what is sample? Population is the whole bulk of the material available for testing. So for testing as we have discussed in a consignment when it is coming for to a particular customer and a lot, a particular lot, whatever number of samples or bobbins are there those are called population. And sample is relatively small fraction of that population so we take small fraction as we have discussed earlier.

So, most of the time testing of the whole population is not possible. So, the population characteristics are normally assist from sample analysis. Now we have discussed the sample. And we have discussed the sampling technique earlier. Now we have got sample. Suppose out of say 1000 bobbin we have selected randomly, whatever, the way we have selected, we have selected say 10 bobbins.

Now from 10 bobbins can we tell, whatever analysis we do mean, whatever standard deviation, whatever started statistical analysis we do, can we asses. Can we tell that the population mean is like this same mean? We cannot tell. But it is not possible. But we can actually guess the characteristics of the population by assessing the sample. Now there will be some confidence.

Suppose if we test 10 sample 10 bobbins out of 1000 bobbins, so we will have certain limit of confidence, okay. Now if we test 100 bobbins out of 1000, then our confidence will be more. That means the number of sample, if we increase that the larger the sample the more confidence we will get so, that we will discuss.

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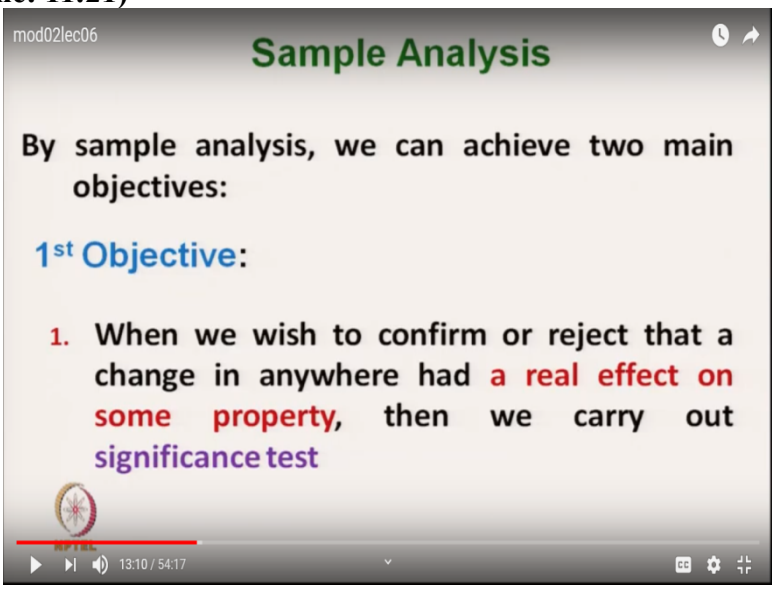

So, by sample analysis we can achieve two main objectives. So, sample analysis, by analyzing sample, we cannot tell that it is a characteristic of the population. We cannot tell. But buy sample analysis we can achieve two objectives. It has got two objectives. The first objective is that when we wish to confirm or reject, that a change in anywhere had a real effect on some property then we carry out significance test. So for significance test, we have to take the sample.

Suppose we have done some experiment. Suppose we have test change the twist. We have changed the twist and you want to know the effect of twist on yarn strength. So, what do you do? We test the sample before changing the twist. We take sample and test the strength before changing the twist and then after changing the twist again we take sample. And from these two samples we can at least tell that the change with whatever the change has taken place, whether it is a real change or we can avoid that effect, okay.

So, that is why that may be significant or maybe insignificant so that significance test we can do by doing the sample analysis. That is the first objective.

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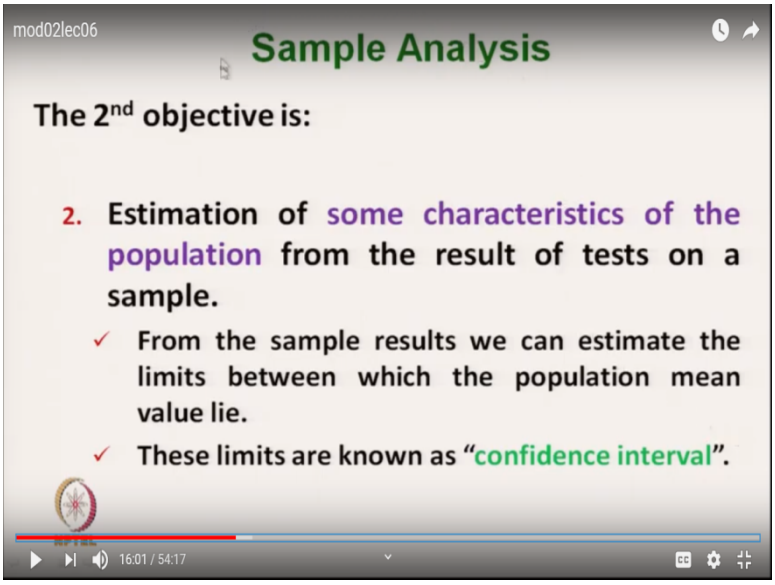

And the second objective is that to estimate, so we cannot actually confidently tell the characteristics of the population. But we can estimate some characteristics of the population from the result of test on the sample. Just we can sum; we can estimate, what is the estimation? From the sample result we can estimate the limit is between which the populations mean value lie.

So, that means suppose a population 1000 bobbins are there it has got strength of say 10 and 1000 bobbin if we test the 1000 bobbin individually and we are getting say, strength of 10 whatever unit. Now from 1000 bobbin if we take sample of say 20 bobbin sample and we test the bobbins, 20 bobbins, we may not reach we cannot get value 10. How do we get the value 10? We cannot get value 10. We can get value little bit may be more than 10 or less than 10.

Suppose we have got value 9.5 now what do you do with that 9.5? Can we tell that if we test 1000 bobbin and we will get 10; that we cannot do because sample cannot tell exactly the value of the population, value of the result for the; from the population. But by testing sample what we can do, we can guess, we can actually predict, the mean of the population. Mean of the population we cannot pinpoint the population, exact population mean 10.

We cannot pinpoint the 10 value. But we can predict the range. We can tell with certain confidence that the population mean is lying between 9 to 11 or lying between 9.5 to 10.5 or lying between say 9.8 to 10.2 like that. So that range we can tell. And with certain confidence and this limit, this range or this limit is known as the confidence limit or confidence interval.

And by sample analysis we can calculate this confidence interval. Confidence interval means, it is not the value. It is a range. The range we will tell us that with certain confidence. It may be 99% confidence, it may be 95% confidence, that certain confidence it will tell us that

okay. The population mean will lie in the within this range okay. Now, to have sample analysis we have to go for the sample distribution. So sampling distribution;

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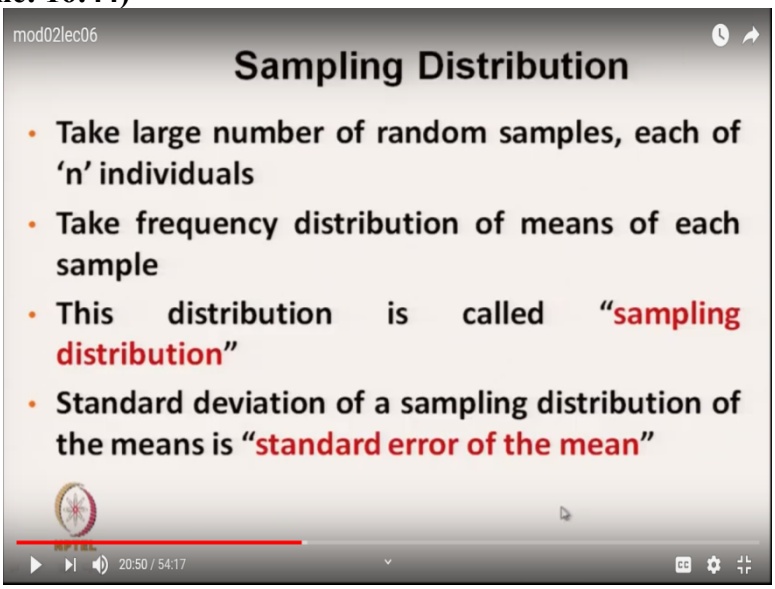

We cannot actually test all the data. All the through the population as we have already discussed. We cannot test the total population. We have to test the sample. Now then what is sampling distribution? In population we have discussed we have actually assume that it is normal distribution. Now what is sampling distribution? In sampling distribution what is the; we have to take the number of sample okay. So take large number of sample randomly from the population okay.

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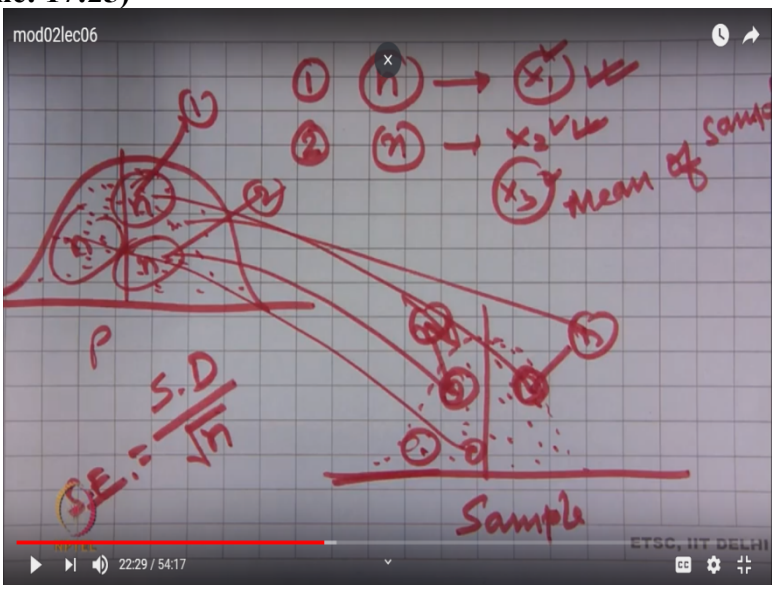

Now let us see, suppose this is whole population okay. This is population and it has got large number of data. Now we cannot test all the data all the samples. Now we have to take the smaller sample. Now and for each sample we are taking n number of data. Now suppose first

we are from the population picking n data okay. So from n data we are getting some value mean so X1. X1 is a mean of the sample, first sample similarly 2n is there. Here again is X2.

This is the mean of the samples. X3 now these are the means, of sample. Now if we can plot again the distribution, the frequency distribution of this mean of the samples okay. Mean of samples what we will get similar distribution. And this distribution is known as Sample Distribution okay. So, this is the normal distribution for population okay. This is for sample.

This is population okay, so as we have discussed so take large number of random samples, each of n individuals. That means the this mean X1 X2 X3 what we have discussed it is a average of n individual data okay. Take frequency distribution of means of each sample as we have discussed. This distribution is called sampling distribution. So we must very clear about the normal distribution of population and sampling distribution okay.

And standard deviation of sampling distribution of mean is standard error of mean. So that is why in population if you take individual data all the individual data and take measures standard deviation say, 1000 data ,1000 bobbins were there, we have tested whole population, that is the standard deviation. Now if we take the standard deviation of sampling distribution mean, then it is called standard error of the mean okay. It is not this term although it is a standard deviation of the mean, but it itself the term is the standard error of the mean okay.

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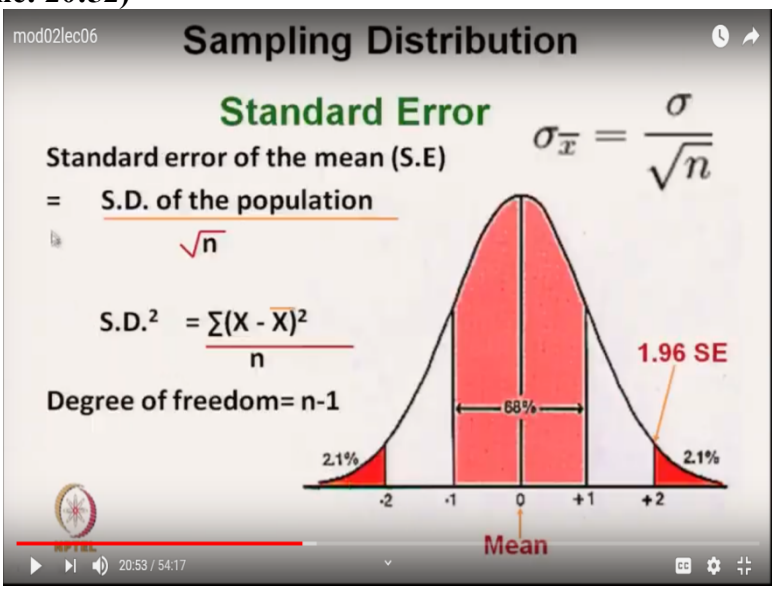

Now here standard error of mean, we can calculate is that the standard deviation of the population divided by under root n, so we can come back again here if we see this is the this was the population. Suppose we have taken this is sample 1, sample 2, sample 3 whatever maybe here n number of samples are there, okay now, the standard deviation of mean of whole population so this is the standard deviation of the whole population.

And if you want to calculate the so this is the value mean value 1. This one is the mean value 2, mean value 3, like that, okay. So this value consists of n' data. The individual, one value, one data okay it consists of the n value of population okay. Each data it is average of n data. That is why as this n data are mixed together here. That is why here standard error of mean is under root n okay. This is the average amount okay.

This similar concept we use for the mixing of the sliver okay and whatever mean sliver and n number of sliver we mean, in that case we divide by under root number of sample, number of strand. This we will discuss. So this is the in same way in standard error of population, error of mean is standard deviation of population divided by under root n okay. And this is the way we can measure the standard deviation and here we can see this is the standard okay, this is the sampling distribution.

In the sampling distribution we do not use the standard deviation. In normal distribution what we have seen, we use plus minus 1 Sigma, plus minus 2 Sigma, plus minus 3 Sigma, like that okay. That is the Sigma is the standard deviation. Here we do not use that standard deviation. Here we use in the term of not the standard deviation, in the term of standard error okay. so, this -+1 standard error of the mean okay.

So error of mean because this is a sampling distribution is the mean of samples okay. That is the difference. So this is the say 1.96 in multiplied by standard of error okay, like that.

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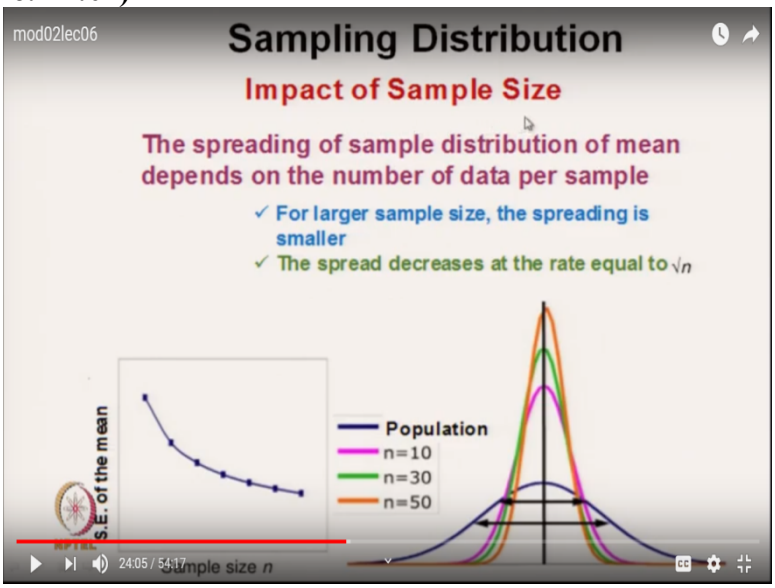

Now, impact of sample size, so if we change the numbers as we have discussed that say 10 or 20 samples 20 samples per n is 20, 20 number of data per sample okay. So, if you change keep on changing the number of samples or data that is sampling distribution curve will get

affected, if we change. The spreading of sample distribution of mean depends on the number of data per sample. So, if you see this is the population.

The black colour this one is the dark blue colour it is a population. Now if we take the sample out of that say 10, 10 sample per; 10 data per sample one sample 10 data then the purple colour or the pink this is the sampling distribution. The spreading will gradually be closer and closer. So, if you take number more number of sample, so your spreading will be closer. That means what does it mean? That means your confidence is increasing.

You are it is closer and closer it is your confidence it is your increasing the confidence. When we will do the actual calculation numerical will do we can see very clearly, that how your confidence is changing with the number of sample okay? For the larger sample size the spreading is smaller. So if you take the larger sample size the spreading will become smaller. The spreading decreases at the rate equal to under root n. That is why and if we see the number of that sample size n and this is the standard error of the mean, it decreases gradually with the number of sample okay, that we have seen earlier. I think it is clear.

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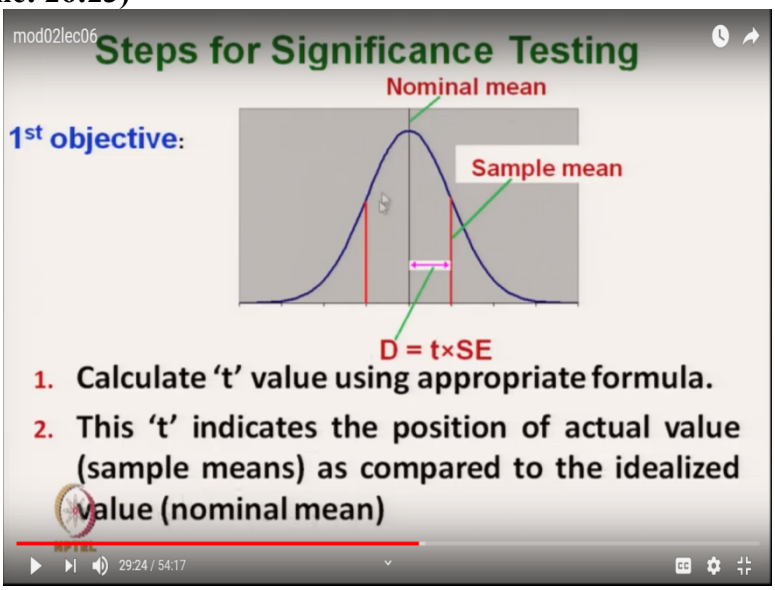

Now we will go the step-by-step, so stepwise how to calculate the how to know the significance okay. So steps for significance testing. So which is our first objective as we have discussed we have two objectives, One is to test the significance whether there is any change or not by doing the Sampling. And second objective is to know the whether the some confidence interval we try to calculate, so that we can estimate the characteristics of the population.

What is estimation? Estimation of the range, okay. Now let us see the first objective steps for significance testing; now this is the sampling distribution. Okay. Now this is the central one is

the nominal mean. So we know this is our targeted mean okay. So this is our nominal mean okay. Now after taking sample what we have got, this one is the sample mean. So this is the mean of the targeted mean of the population.

Now this one is the sample mean. And this difference in mean is expressed in terms of standard error. Earlier what we have seen in normal distribution, the difference was expressed in terms of the standard deviation. But in normal distribution it is as we have mentioned that it is a standard error 20 number of database sample okay. And there we have discussed plus minus 1 Sigma, plus minus 2 Sigma like that.

That, one time of Sigma 2 times of Sigma, here it is t times of SE. So, t is the; we can get standard value from the table. This is the t distribution table. So t we can indirectly calculate by the difference in the mean divided by the standard of the error. So then how to calculate the t? To calculate the t value using the appropriate formula we can calculate the t value.

So, t value we can calculate. This t indicates the position of actual value. This is the actual value. As t increases this will be moving away when t decreases this will move closer. So, t indicates the position of actual value that is sample mean as compared to the idealized value that is the nominal value that is how we can calculate.

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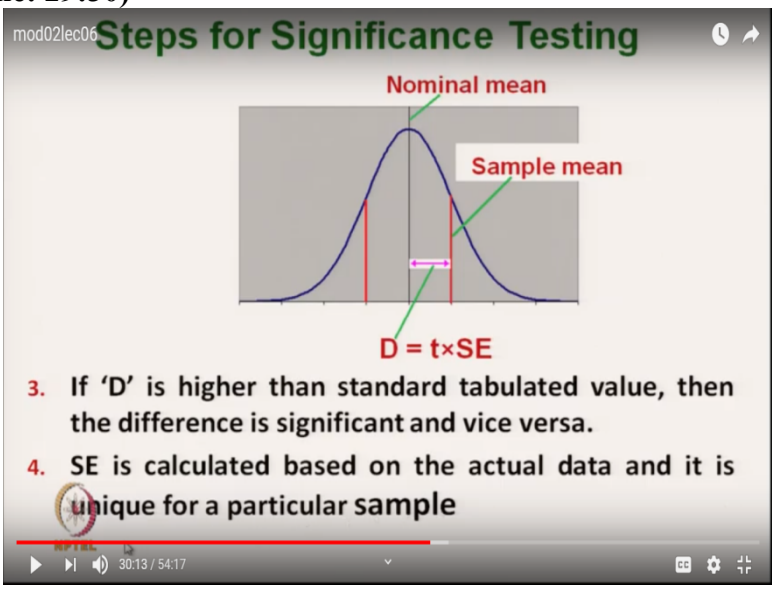

Now the steps, the third step is it if D is high er than the standard value so this D value if it is done then the difference is significant. So, D known okay from D we cannot compare. D is, we have to compare in terms of t value so t is calculated, then D divided by SE. So then the difference is significant and vice versa okay. Standard error is calculated based on the actual data and is unique for a particular sample. So, for any sampling distribution standard error will be unique okay. So, first we have to calculate the Standard error.

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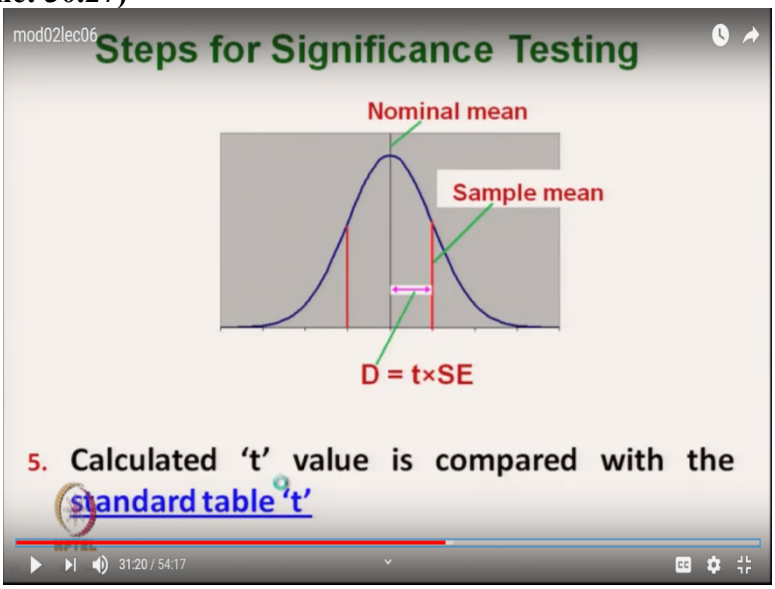

And then we have to calculate the t value. This t value, so D is known because our nominal value is known, our sample mean is known that already we have calculated and then the standard error we can calculate using the formula which is unique for any sample distribution. And then D divided by standard error we have calculated the t value. So, this t value which we have calculated here based on the sampling mean, then we have to compare with the standard t table.

And this t table we can calculate. We can compare. Now let us see, so this if the t value calculated t value is more than the standard t value, then the difference is significance.

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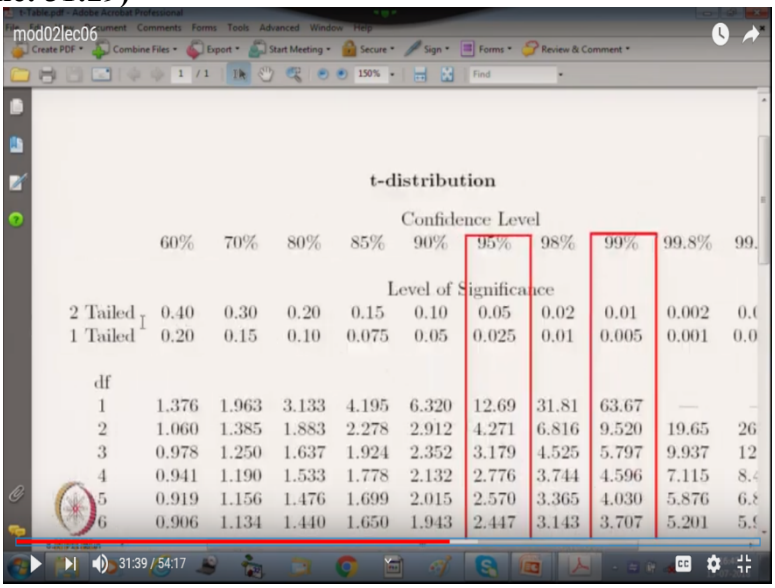

Now try to see here these are the t table okay for different degree of freedom, for one degree of freedom, and at different confidence level. So, it starts with 60% confidence level, 70%, 80, 85, so typically we use two different terms of confidence level, one is 95% confidence

level, another is 99% confidence level okay. This is the most commonly used, so 99% commonly used level confidence level and depending on the number of data, so typically number of data the degree of freedom is number up n - 1. So, if we have to say 20 data 20 the degree of freedom will be say 90 so you can check okay.

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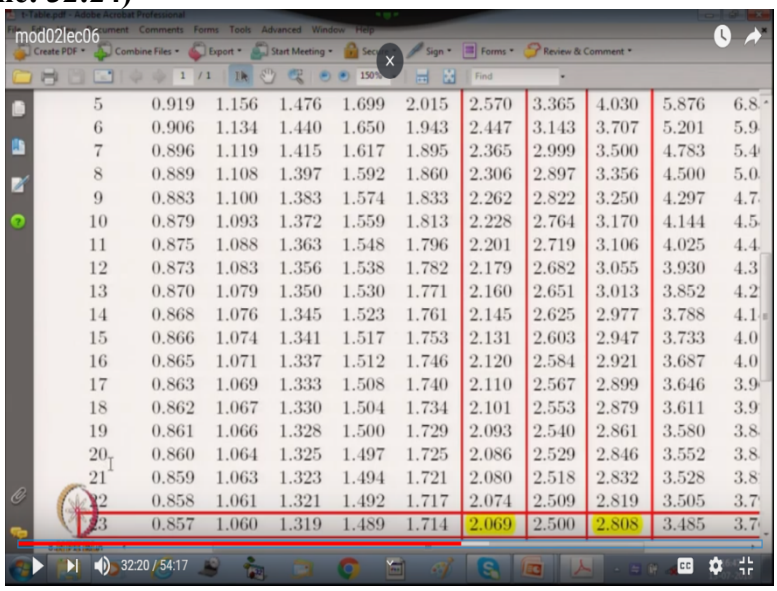

5	0.919	1.156	1.476	1.699	2.015	2.570	3.365	4.030	5.876	6.8
6	0.906	1.134	1.440	1.650	1.943	2.447	3.143	3.707	5.201	5.9
7	0.896	1.119	1.415	1.617	1.895	2.365	2.999	3.500	4.783	5.4
8	0.889	1.108	1.397	1.592	1.860	2.306	2.897	3.356	4.500	5.0
9	0.883	1.100	1.383	1.574	1.833	2.262	2.822	3.250	4.297	4.7
10	0.879	1.093	1.372	1.559	1.813	2.228	2.764	3.170	4.144	4.5
11	0.875	1.088	1.363	1.548	1.796	2.201	2.719	3.106	4.025	4.4
12	0.873	1.083	1.356	1.538	1.782	2.179	2.682	3.055	3.930	4.3
13	0.870	1.079	1.350	1.530	1.771	2.160	2.651	3.013	3.852	4.2
14	0.868	1.076	1.345	1.523	1.761	2.145	2.625	2.977	3.788	4.1
15	0.866	1.074	1.341	1.517	1.753	2.131	2.603	2.947	3.733	4.0
16	0.865	1.071	1.337	1.512	1.746	2.120	2.584	2.921	3.687	4.0
17	0.863	1.069	1.333	1.508	1.740	2.110	2.567	2.899	3.646	3.9
18	0.862	1.067	1.330	1.504	1.734	2.101	2.553	2.879	3.611	3.9
19	0.861	1.066	1.328	1.500	1.729	2.093	2.540	2.861	3.580	3.8
20	0.860	1.064	1.325	1.497	1.725	2.086	2.529	2.846	3.552	3.8
21	0.859	1.063	1.323	1.494	1.721	2.080	2.518	2.832	3.528	3.8
22	0.858	1.061	1.321	1.492	1.717	2.074	2.509	2.819	3.505	3.7
23	0.857	1.060	1.319	1.489	1.714	2.069	2.500	2.808	3.485	3.7

So, here suppose we have say 24 data one example is 24 data and this we have to calculate whatever the t value we have calculated so 23 is the degree of freedom then we can compare with these two value 2.069 and 2.808. Now if our t value is say 2 or 1.5 calculated t values, then we can very well say that there whatever difference they are not significant at both 95% significance level and 99% significance level.

And if these are value t value we are getting say 3 then this t value is more than this 2 then you can say whatever difference is there it is actually there is a real difference there significance differences there. And if the data is in between these two then we can tell okay, there is little evidence is there but actual difference is not there. Because at 99% confidence level this is insignificant. That we can say.

We may not take any action we may not visit the sample okay. We can tell that statistically it is not significant okay. And second objective is that to estimate.

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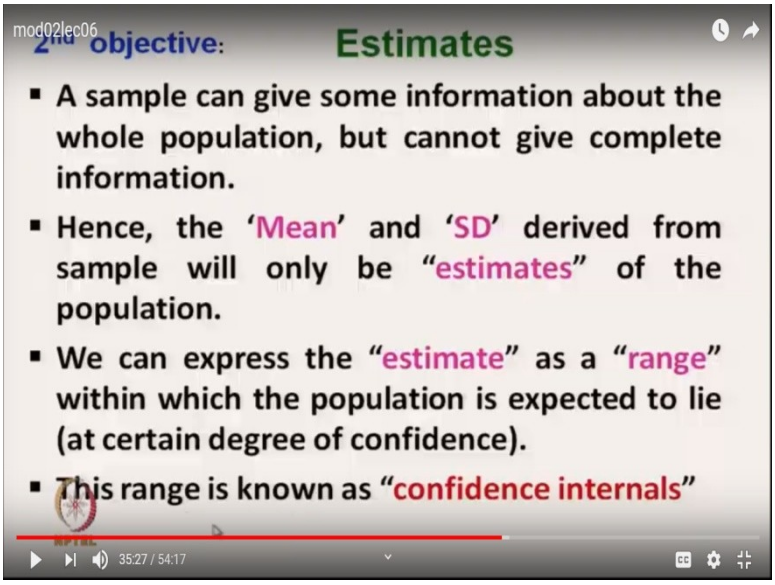

To estimate the characteristics of the population to estimate the range or sample can give some information about the whole population. But it cannot give complete information. Like it cannot tell, this is the mean. Hence the mean and standard deviation from sample will only be estimates of the population. These are the estimates. So, if we take the sample and sample mean we have calculated or standard deviation we have calculated, this will give us some estimates okay.

And we can express the estimate as range. We can tell in this range which within which the population is expected to lie, okay. At certain degree of confidence that you can tell at 99% confidence level, this is the range okay. I can tell with 99% confidence that the range that the population mean will lie in between that. That means suppose we test any data sample data and we have got the estimate the confidence range of same 10 to 12 okay, at the 99% confidence level.

That means out of 100 data out of 99 times the probability is that the confidence that population mean will also lie in that range. This range is known as confidence intervals okay.

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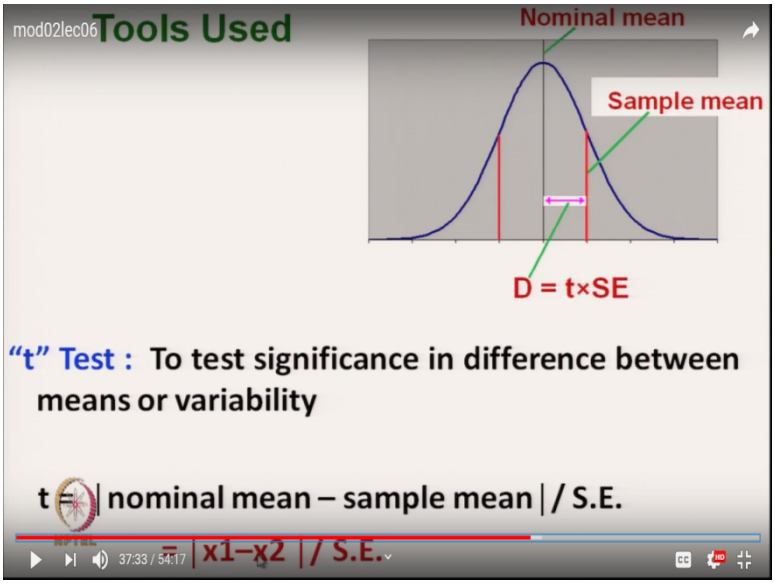

Now let us see what are the tools we use to understand the significance test? To do the significance test or to know that whether there is any real difference is there or not okay. So, first is the t test, t test can be actually applied, if you want to test the difference between the mean or difference between the variability. So, suppose two samples are there, okay. Sample one has got standard deviation of say 5 and sample 2 of standard deviation of say 6.

So, this standard, the variability weather 5 and 6 is this difference is a really there is a significant difference or not, that we can test variability. And also we can test the mean. So one sample the strength, suppose mean strength is a 50 and another is 52. So whether this 50 and 52 is the difference is really significant difference or not that we can verify by t test okay. And what is that t test, t value we have seen earlier.

So D is the difference. What is that mean t difference means, nominal mean minus sample mean .This is under modulus because, it may be negative or positive, we will always take the positive value. It may be on the left side or right side, so t is equal to this D value D is nothing but nominal mean - sample mean divided by the standard error okay. So, that t we have to calculated, X1 minus X2 by standard of error. Okay.

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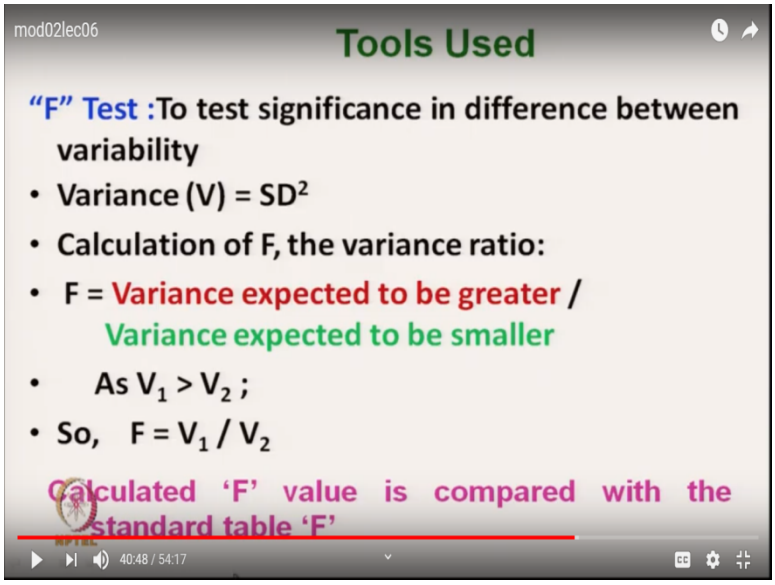

Next is that F test. F test is also done for significance test. But here F test is only used for the significance difference between the variability. It does not take care of the mean value. So, there are in any sample, there are two characteristics one is the mean, another is the variability, standard deviation or coefficient of variation okay. The F test is it takes care of only variability that significance difference between the variability.

And what is variance? Variance is the square of standard deviation. And F is nothing but the ratio of the variability, ratio of the variance okay. Now how to calculate F the; it is called variance ratio. Now, one should be very careful, one should be it is that variance F value is always more than one. We have two data like one is variance one and another is variance 2.

But we should know that which one is more? Whether the variance of sample 1 variation is more or sample 2 variations is more? The higher variation will always go in the numerical data. So, variance expected to be greater okay. And then variance expected to be smaller. So, this ratio, so F value to have a value more than one that we can have. So we have to say 2 variance values FV1 and FV2. These are the variation value. We must know that which one is more.

And higher variants value we always call it as V1 It is the basically normal understanding okay. It is a convention that always take V1 as a higher value which is which goes into the numerical value. So V1 is higher than V2. That means what will be the F value. F is V1/V2. So, this is the F value. Now we have calculated. So, 2 standard deviation SD1 and SD2, SD1 we have two squares that will become SD1 and SD2 and depending on which one is high will put the value either V1 or V2 okay. And then the calculated F value is compared with the standard table. Standard F table okay. Here the standard f table it is given.

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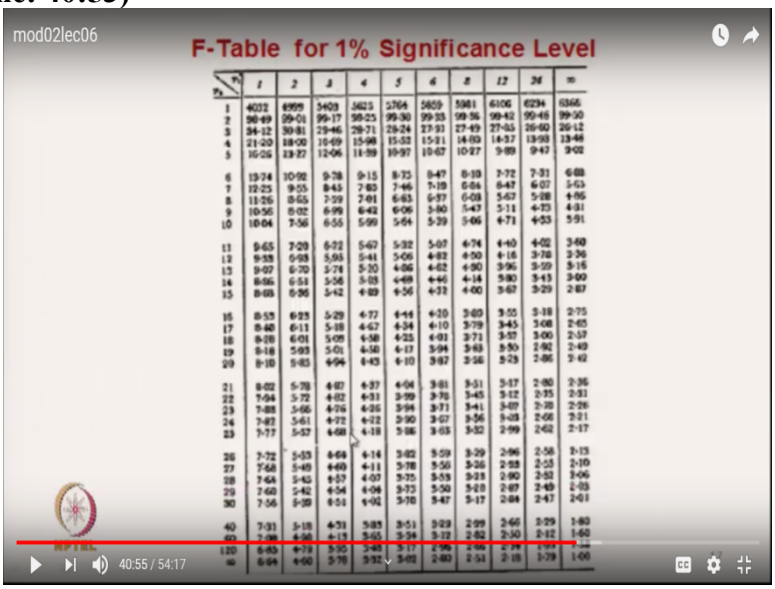

Now we can see here, the standard step, it is for 1% signification level that means 99% confidence significance level, okay. This, this is the in horizontal this row shows the degree of freedom for V1, okay. That means that number of sample -1. It is for always this side is for higher value V1 and vertical is, this is for V2. That is for denominator value okay. Whatever and accordingly we can get the value okay.

Similarly for 95% significance level and if you compare this value with the actually calculated value and if this calculated value is more than the table value then we can tell that the variability is significant okay. So this is the F test value.

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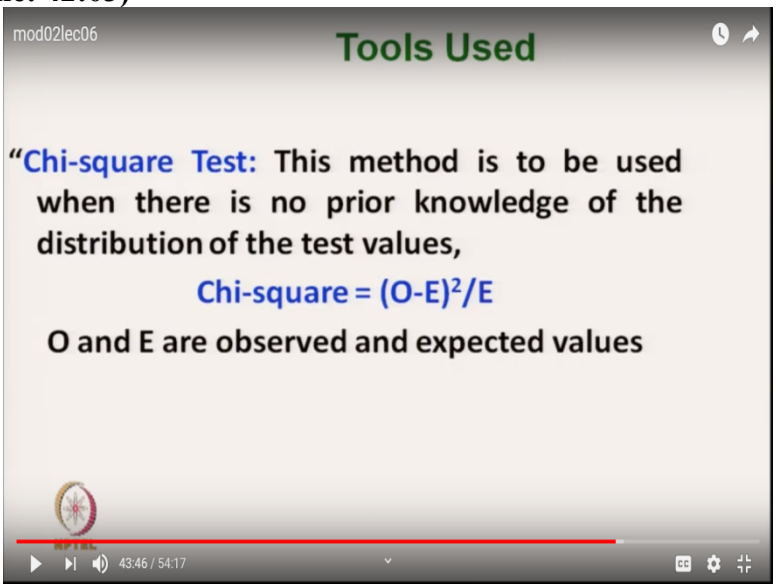

And third one is that, it is a Chi square technique. In Chi square this is used when there is no prior knowledge of the distribution of the test value. So, in earlier cases t test and F test we know it is a normal distribution and all these things. But here if you do not have any

information, if you do not know the standard deviation value nothing is known. In that case we can use the Chi square technique. The chi-square table is there, okay that we can use.

So, this is the observed value O and then expected value. So suppose, one some test result we expect it has to be 10 okay and we have observed that the value has become 9, okay. And we want to know and we do not have any other data. We do not have standard deviation. We cannot calculate the standard error, okay. We cannot calculate it. So in that case what we do? So you simply use the observed value 10.

Observed value say 10 and expected value say 15. Whatever, so whatever so that we use and we can calculate the Chi square value and this value we can from the table Chi square table, we can compare. And then we can tell that whether this, the difference is really significant or not okay. So, these are the three techniques, we can use for significance test, okay.

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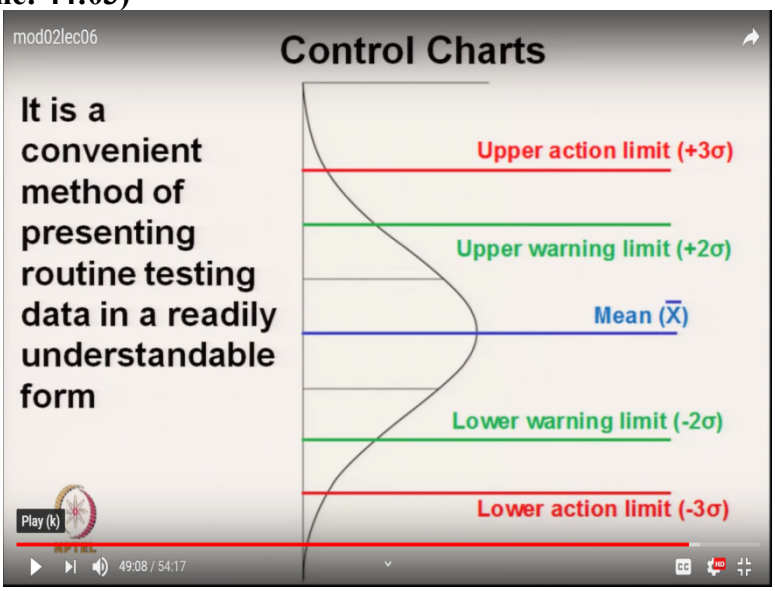

Now another system, another technique, which is used in textile industry, very frequently which is called control chart, okay. And it is a very convenient. You do not have to calculate on the regular basis. Based on the experience, we can form the control chart. And it is the visually one can say, whether the total process is under control or not. The system is running perfectly or not, that we can guess from the by looking at the control charts.

And it is not the, in a particular day. Even for throughout the month we can see that what is happening in the production, in the data okay. It is a convenient method of presenting routine testing data in a readily understandable form. So one can immediately tell, looking at the okay, your process is going fine or not okay. So that is this is the control chart, where the mean is known. That is the say targeted value it is the nominal value.

It is a fixed that is our target, okay. Now the upper limit, there are two types of value limit are there. One is that warning limit and another is called action limit. The warning limit, it depends on the industry to industry what at what level they would like to have. So, if we fix one limit will be plus minus 2 Sigma okay. Plus minus 2 Sigma and it is not fixed. We can have depending if we, our requirement say more stringent, then we can set plus minus 1 or whatever limit, okay.

Now this is the upper warning limit and lower warning limit plus minus 2 Sigma and plus minus 3 Sigma is the action limit. So, what does warning limit mean? Warning limit means we do not have to take immediate action. Let us take example. So, this is the mean value suppose we are trying to produce yarn with 30's count okay. This is the count chart. Count control chart, with that 30's count is there. And this Sigma we do not know the Sigma.

That is the expected sigma, expected standard deviation. That is from our experience. So we from say last one year data, last 2 year data, we came to know we are getting say Sigma of say 0.5 okay. Now this is say 30's count and plus two Sigma means it will become 31 and 29. So, 31 count and 29 count. And plus 3 Sigma we can calculate there. So 31 count and 29 count whatever so that means our allowable count is say 29 to31.

Now it depends on us whether should we allow it or not, should we set warning limit from 29 to 31 or we would like to have from 29.5 to 31.5. So, that depending on that and depending on the variability we can calculate. And one must be very careful we cannot unnecessarily make the limit stringent because we will not be able to achieve. So that in that case projection will be too high and unnecessary we will take action.

So depending on the allowable achievable standard deviation we say that is why in normal practice it is a plus minus 2 sigma limit is a normal industry they have to follow within plus minus 2 sigma limit it is warning limit. So, do not take action and then plus minus 3 sigma limit, if it crosses then we have to take immediate action. Suppose we are in plus minus 2 sigma limit it is a 31 to 29 to 31, okay.

In that case if we start taking action, then it will be too much then you cannot actually run your machine. But if you start allowing more than that then you will get start getting compliant. Because it is you can control that one. So, that is how we typically plus minus 3 Sigma limit as we have seen, it is typically 99.9% data will be always there. So if it goes beyond that then and if it repeats then you have to say it crosses the control.

If it goes once in 1000 times or something then you can say by chance. But if it that value repeats then you have to immediately take action okay.

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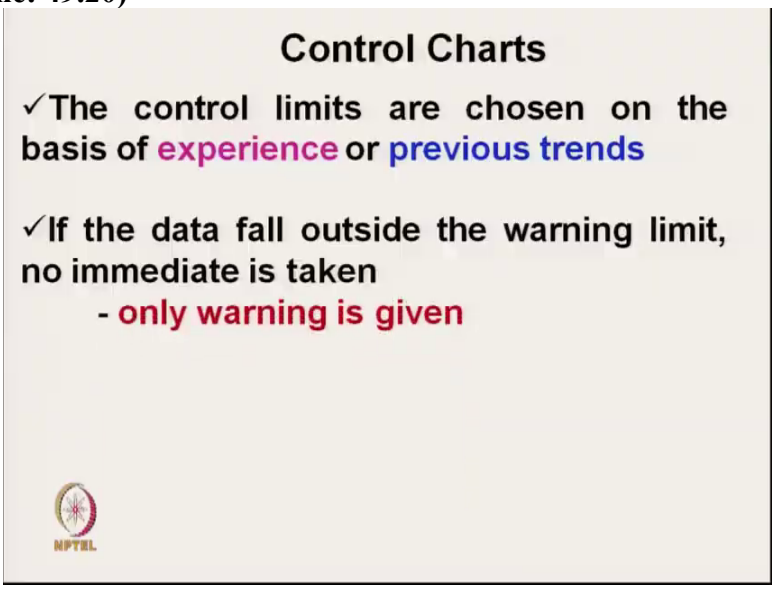

So, the control limits are chosen on the basis of experience and previous trend. We cannot randomly select. So that is as I have mentioned. If we select closer limit, then unnecessarily we will have to take the action which may not be required and also there is no solution because our machines, particular machines can produce standard deviation of certain limit. So that is the, limitation.

If we try to achieve better than that, it is not possible. So, unnecessarily we can that is why based on the experience and previous trends, we can we have to select the limit is. If the data fall outside the warning limit, we should not take immediate action. Immediate action is not required. Because, then there will be large number of data. So that in that case only thing one has to be warned that okay.

You take proper action, you like for yarn count variation, whatever the back process requirement, one can keep warning like for yarn say count variation crossing the warning limit. Then one can tell take action in carding, blow room or draw frame. So that that count variation is actually minimized. But only warning is given.

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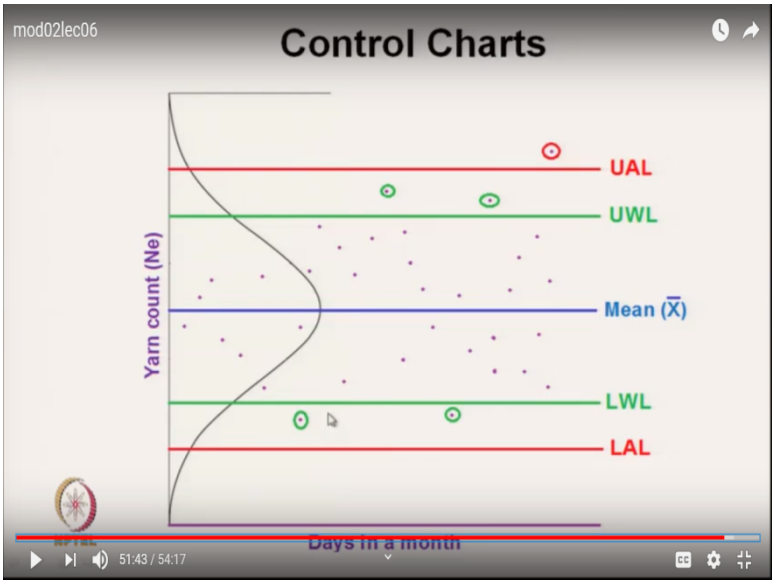

But if it is crossing the limit, this one after upper action limit, in that case this is there here if it is crossing then we can take action. Now if you see this is the yarn count data throughout the month for throughout the month, this is count data. So in a different day we are taking count. So, mean count of particular date, or a particular lot, okay. So Day 1, this is the count ,day 2, day 3 ,day 4, day 5, in that way different days we have count.

And in certain date, we found that this is the yarn count in any that means it is lower value. It is giving course annual. It is okay. Now this closer or one can always try to analyze by why it is coming closer. And immediately it has taken action has been taken, it has again come back to normal position. And suddenly it is certain date, particular day it has been observed that this is coming finer. So immediately action has been taken.

But the warning has given warning has given. But they have taken some precaution. It is not action. It is a precaution they have taken. Again it has come back, in that way so this will go cross. But once it is crossing this limit then, immediately action has to be taken. You can stop the machine. You can recheck. You can even send back the draw frame, redo the all these, reprocess all this material, and finally we will get the correct result okay.

So, this all these data one can, take action and this is at this is called the upper action limit okay. So, the advantage of this is that this is this picture, if I go to the shed or if I go to that laboratory, I can tell that okay, throughout the men what had had happened and how many times this has caused the warning limit. That also will be given will show that it is a performance of the particular process how many times it is crossing the one, ideally, it should be within this warning limit okay.

And if it crosses repeatedly the action limit then proper setting of the machine, proper selection of the raw material, everything has to be done, okay. And we will stop here and in the next class we will do all the numerical's based on the practical examples okay. Thank You.