Evaluation of Textile Materials
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Module No.# 02
Lecture No.# 07
Sampling Methods and Sample Size: Practical Statistics (Contd.,)

Hello everyone. Now our today's topic is that the numerical based on practical examples okay. In last class, we have discussed theoretical importance of Sampling distribution and the significance testing and how to do significance testing, the techniques, t test, F test. And also we have discussed the confidence intervals okay. And today, we will try to see with practical examples, the, how to calculate and how to actually get some conclusion, how do we reach to some conclusion with some practical examples.

And here what we have done? Here the examples are based on the textile industry okay. Data, we have taken from textile industry.

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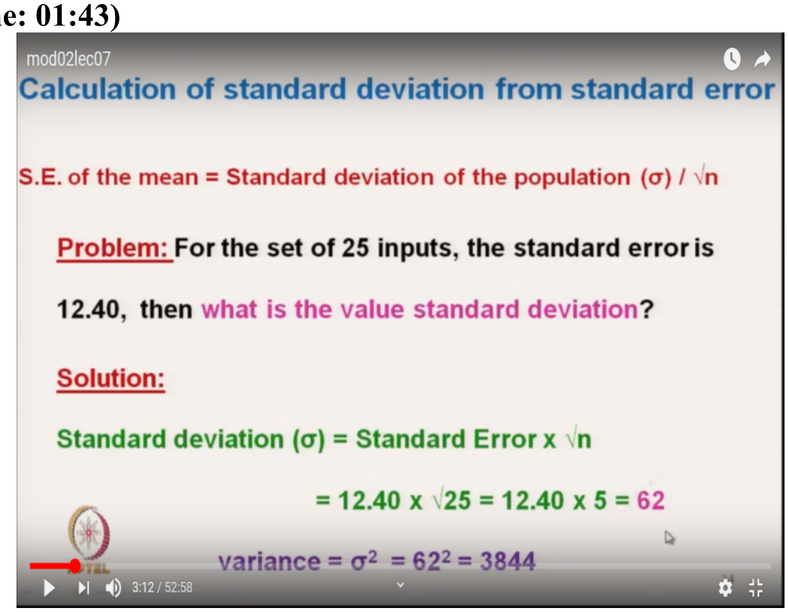

First is that how to calculate standard deviation okay? If we know the standard error, so the standard error the problem could be like this. For a set of 25 inputs the standard error is given 12.40 okay. Then what will be the value of standard deviation? So we want to know the standard deviation of population. And if we know the value of this standard error, okay. So, it is very simple. We know the formula of standard error. Standard error of mean is the standard deviation of population divided by under root n, where n is the number of input number of data.

So, here if we see the number of data is 25 and standard error is given 12.4. So, 12.4 * under root n, that is 25. It comes out to be 62. So, 62 is the standard deviation of population that is there. And if you want to know the variance, variance is this value, so that way we can calculate. If we know the standard deviation of population, we can calculate the standard error of mean or vice versa okay. And also if we know the standard error of mean.

Suppose standard error of mean is given and standard deviation of population is given. From there we can calculate the n value also. So, using this formula we can calculate, if 2 are given we can calculate 1. It is very simple one. Now try to understand, try to go see the next numerical.

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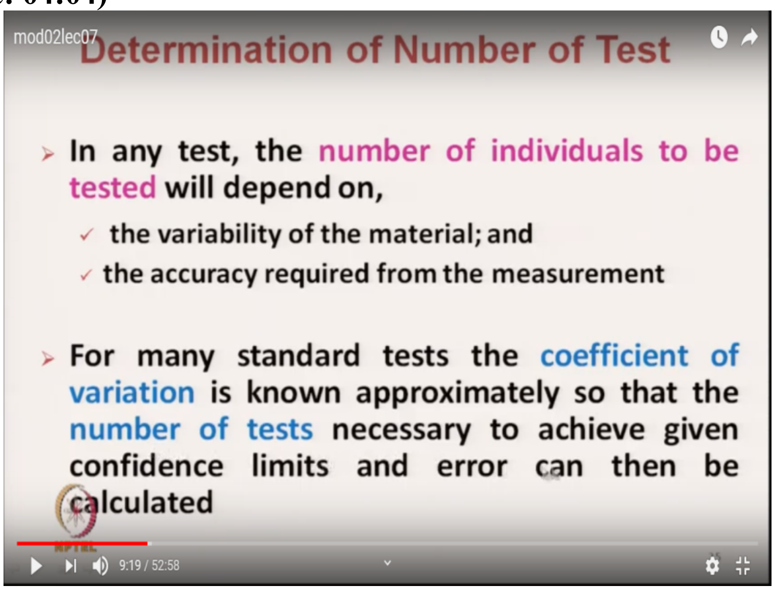

Next is that the problem is that it is a number of test. It is very important particularly in industry also and most important is that it is the in research. In research studies, we must know how many data we have to take to get certain confidence. With certain data of confidence with certain confidence limit, okay we can, we can tell this data, and this result is perfect okay so, to determine the number of test. So, in any test the number of individuals to be tested will depend on.

So, how many test we have to do. Suppose for any data any experiment we may say 4 sample, we may take 10, we may take 50. So, it cannot be arbitrary. Okay. We should know that how many test we have to perform. So, it depends upon the variability of the material. Suppose whatever experiment I am doing, whatever product we are developing, we are producing, if it is highly variable, variability is very high then we have to take large number of data, in the sample.

We will see in the calculation okay. By calculation by numerical's we can see this experiment, this value, this conclusion, we will try to prove.

So, the variability of material if it is less, suppose the material we are producing which is variably it is very less, in that case the number of sample required will be very low. Let us take the example of polyester filament, say monofilament and staple yarn, cotton staple yarn. Now we would like to know the number of data required to calculate the U%, or diameter variation. So, as the cotton yarn is highly variable in nature.

So, to have certain confidence in the data, we have to test large number of data, okay. We have large number of sample. On the other hand polyester filament it is coming out. It is a monofilament. It is coming out from the spinner rate with single spinner rate and variability is not there. In that case obviously we may not need large number of data. And with a certain confidence, we can tell that this data result is it is actually valid.

So why, because, the due to the less variability we can because here standard deviation is less in case of polyester monofilament. So, then next is that, very the accuracy required from the measurement. Now if we know if we sell, okay, I do not need that much accuracy in my data okay. It is accuracy is not that important okay. That is okay it will work. I want, I need, only some idea. In that case, number of sample will be less.

And if we need highly accurate data, very accurate data with the high confidence level in that case we need large number of data. So this large number of, smaller number of, is okay. But what is the value? So we will now see how to calculate, how to actually specify the number of test okay? How to determine the number of tests based on known target of accuracy, or known variability level okay. If we know the variability or if we have the targeted accuracy, error, targeted error value, then we can calculate the number of test required.

For many standard test, the coefficient of variation is known approximately so that the number of test necessary to achieve the given confidence limit and error that can be calculated. So, most of the cases, our standard deviation or coefficient of variation is known and we our targeted error value is given and then for a certain confidence limit, we can calculate the number of test. So, we must know the variability and we must have the targeted error 1evel. Then we can calculate the number of test with a certain confidence level. So we can have 95% confidence level or we can have 99% confidence level okay.

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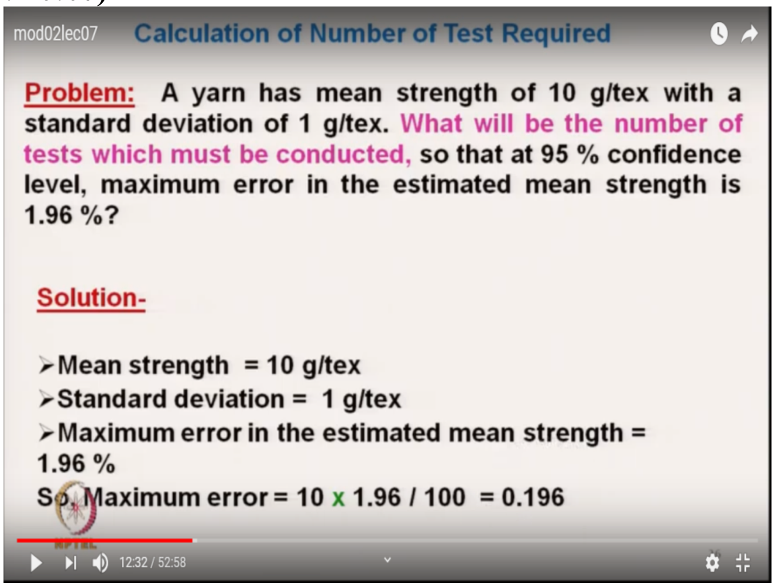

Now let us take example. So calculation of number of test required okay. First problem is that yarn has mean strength of 10 gram per tex. That is the mean strength with the standard deviation of 1 gram per tex. This is given. What will be the number of test which must be carried out? So that at 95% confidence level, the maximum errors, in the estimated mean strength is 1.96 %. That means what does it mean?

The target is that I can allow maximum error percent in my data 1.96% that is the allowable data. So beyond that I do not, I cannot allow 2% data, whatever reading I am taking. So I can allow only 1.96% maximum error and maximum error of 1.96% of what 1.96% of 10 gram per tex. Then that is mean value. So the mean can vary 1.96% + side or 1.96 % - side, within the range it is mean is allowed. And standard deviation is known.

And I have to calculate at 95% confidence limit, okay. Now what are the given data? Mean strength is given 10 grams per tex, okay. Next what is given? Mean deviation is given, Standard deviation is given, it is 1 gram per tex is standard deviation. Now maximum error it is given in percent it is not in value. So, that in that case, we have to convert it to in terms of value. So 1.96% of 10 What is that? It is a 0.196 that is a 0.196 is the maximum limit that is allowable. What is that limit?

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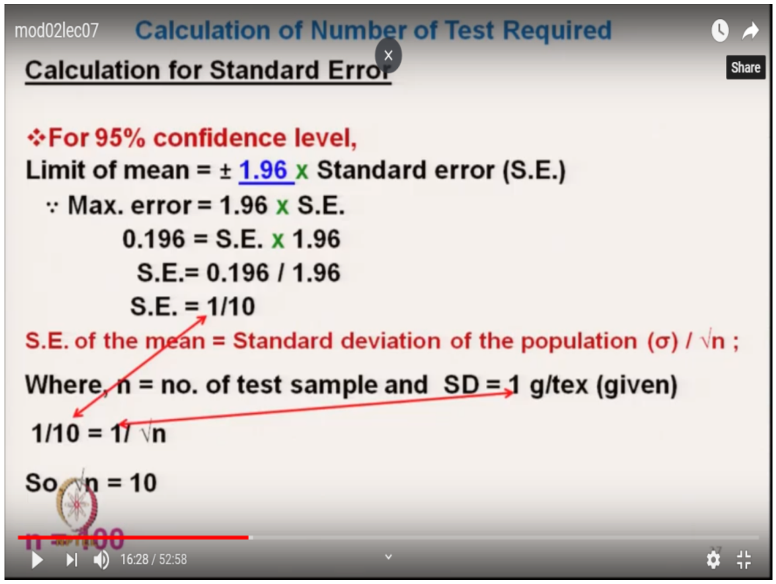

0.196 that limit is that it is a standard t value multiplied by standard error. This t value that we have seen earlier that limit, the maximum limit is the value D, the D we have seen it is a t multiplied by standard error that is the maximum limit of the day. It can be it can go in the plus side and minus side okay and this why this t value is 1.96. Because we have large number of data which we can considered as infinite. And from the t table at 95% confidence level, if we see the table.

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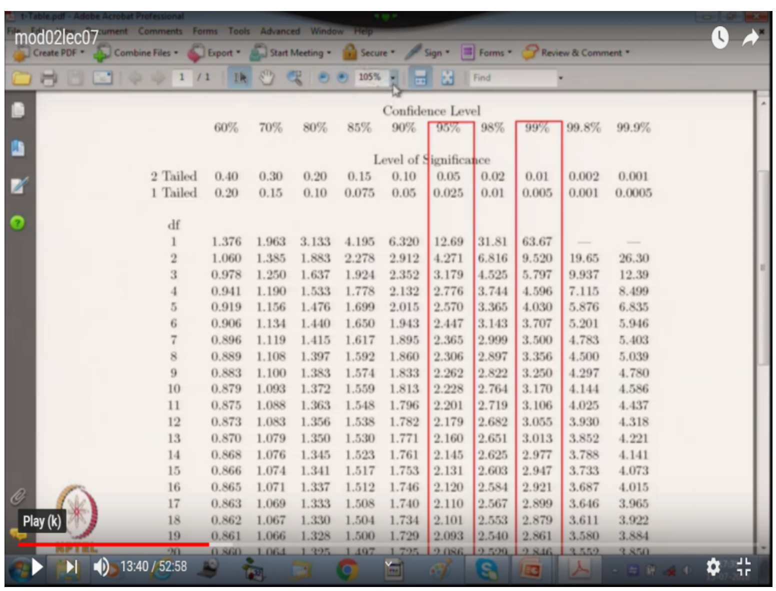

	Confidence Level									
	60%	70%	80%	85%	90%	95%	98%	99%	99.8%	99.9%
	Level of Significance									
2 Tailed	0.40	0.30	0.20	0.15	0.10	0.05	0.02	0.01	0.002	0.001
1 Tailed	0.20	0.15	0.10	0.075	0.05	0.025	0.01	0.005	0.001	0.0005
df										
1	1.376	1.963	3.133	4.195	6.320	12.69	31.81	63.67	—	—
2	1.060	1.385	1.883	2.278	2.912	4.271	6.816	9.520	19.65	26.30
3	0.978	1.250	1.637	1.924	2.352	3.179	4.525	5.797	9.937	12.39
4	0.941	1.190	1.533	1.778	2.132	2.776	3.744	4.596	7.115	8.499
5	0.919	1.156	1.476	1.699	2.015	2.570	3.365	4.030	5.876	6.835
6	0.906	1.134	1.440	1.650	1.943	2.447	3.143	3.707	5.201	5.946
7	0.896	1.119	1.415	1.617	1.895	2.365	2.999	3.500	4.783	5.403
8	0.889	1.108	1.397	1.592	1.860	2.306	2.897	3.356	4.500	5.039
9	0.883	1.100	1.383	1.574	1.833	2.262	2.822	3.250	4.297	4.780
10	0.879	1.093	1.372	1.559	1.813	2.228	2.764	3.170	4.144	4.586
11	0.875	1.088	1.363	1.548	1.796	2.201	2.719	3.106	4.025	4.437
12	0.873	1.083	1.356	1.538	1.782	2.179	2.682	3.055	3.930	4.318
13	0.870	1.079	1.350	1.530	1.771	2.160	2.651	3.013	3.852	4.221
14	0.868	1.076	1.345	1.523	1.761	2.145	2.625	2.977	3.788	4.141
15	0.866	1.074	1.341	1.517	1.753	2.131	2.603	2.947	3.733	4.073
16	0.865	1.071	1.337	1.512	1.746	2.120	2.584	2.921	3.687	4.015
17	0.863	1.069	1.333	1.508	1.740	2.110	2.567	2.899	3.646	3.965
18	0.862	1.067	1.330	1.504	1.734	2.101	2.553	2.879	3.611	3.922
19	0.861	1.066	1.328	1.500	1.729	2.093	2.540	2.861	3.580	3.884
20	0.860	1.064	1.325	1.497	1.725	2.086	2.529	2.846	3.552	3.850

And this t table will give us the value this is the 95% confidence level. Here if I little bit enlarge at infinite level. The large sample infinite level means, which is large sample it is 1.96. This 1.96 is the t value. And here this t value is taken here. So that the limit means the maximum limit allowable is equal to 1.96 from the t value we have; the t table we have got and multiplied by standard error. And what is the limit of mean?

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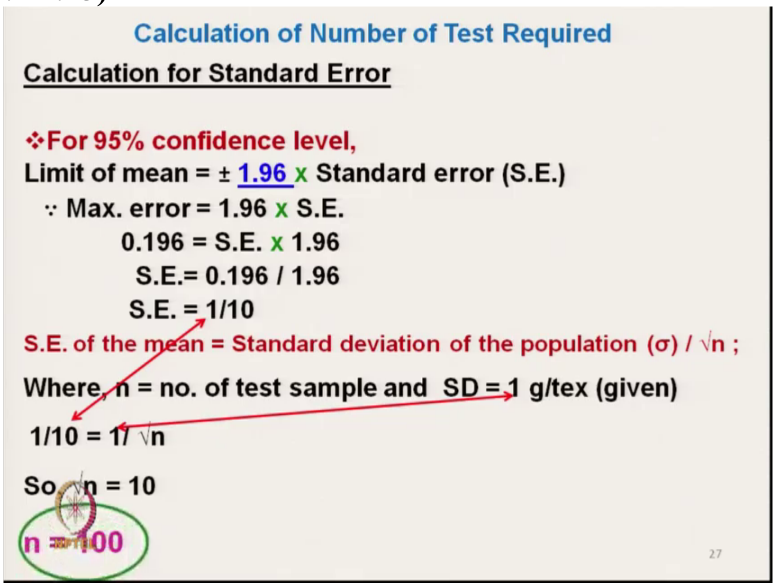

That limit of mean that we have calculated already this limit of mean is it is a maximum error allowable. And maximum allowable what to we have seen earlier. It is a 0.196 that is 1.96% of 10. So 0.1 96 is the maximum error * standard deviation * 1.96 okay. So we got we can calculate the standard error of mean. From here we calculate the standard error of mean what is the value of the standard error? It is a 1/10 so, 0.1, so standard error we have to calculated. Now our target is to calculate the number of sample tested.

So what we have done? We have calculated the standard error okay. Knowing the limit error okay, maximum error from the; and 1.96 the data came from the confidence level okay. So, the formula says that standard error of mean equal to standard deviation of the population by under root n, n is the number of sample and n the number of sample and standard deviation is given already. It is the population standard deviation is given one gram per tex.

So from there we have to calculate the value of n. So, 1/10 which is standard error this is a standard error, so standard error 1/10 ok equal to 1. What is 1? This 1 is the standard deviation okay and divided by under root n. This is the number of sample which we want to calculate, okay. So under root n = 10 and n will be equal to 100. Okay. So this is the answer.

So, if we take, now the conclusion is if we take 100 test 100 reading, 100 samples, okay and in that case we can tell with 95% confidence, that the test result, whatever test result is there, sample result the error will be, maximum error will be 1.96%. So, the significance of this test is that, we can tell at certain confidence. Now suppose we want to shift our confidence. We want to shift our confidence to 99% okay. Now what happened to the number of test?

In that case, if we shift the confidence, if you want to have more confidence in that case our number has to be more. Now let us see with the same example just by changing the confidence level, let us try to see the; calculate the number of samples. Now here the problem is exactly same.

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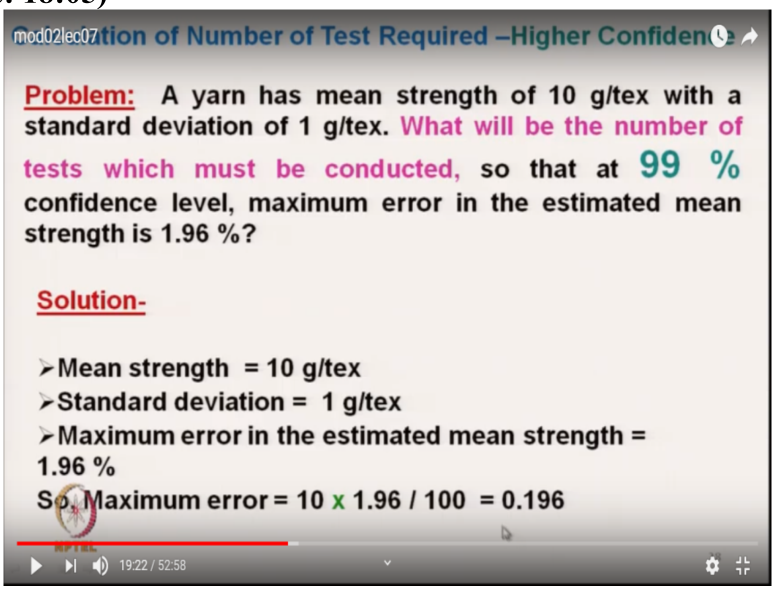

Yarn has mean strength 10 gram per tex with the standard deviation of 1 gram per tex. What will be the number of text which must be conducted, so that at 99% confidence level maximum error in the estimated mean is 1.96%. Earlier also, it was there. But the error was 1.96% but if we take 100 reading. That means out of 100 time 5 time I will be wrong, 5 time there will be the data may cross this things.

But if we try to know at 99% confidence level that means we want to miss only 1% but 99% time I will be correct. So let us see what will be the number of test required? The same way, it will go mean strength, standard deviation, maximum error in the estimated mean strength that is 1.96%, that is maximum error and maximum error value is exactly same.

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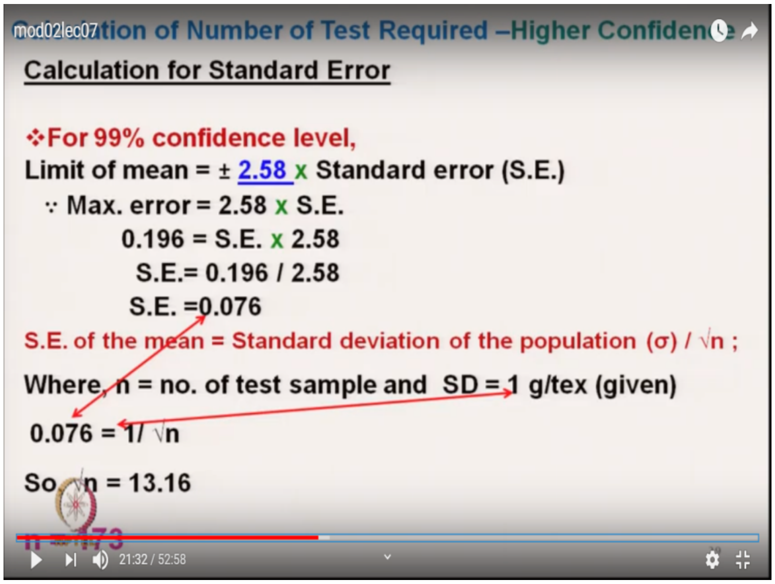

And here the only thing is that it seems to 99%. So with 99% what is changing here? Here the t-value has got changed. Earlier it was 1.96 at 99% confidence level with say large number of data. Let us see with the large number of data.

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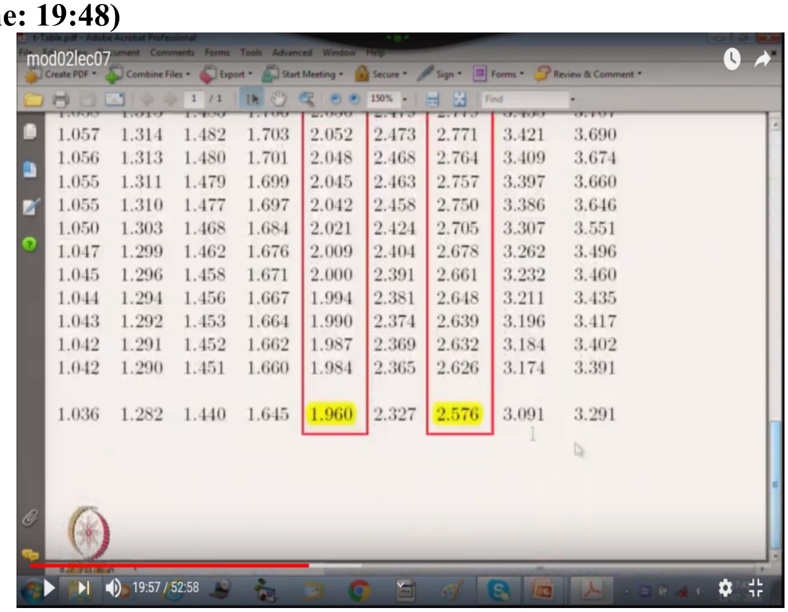

1.057	1.314	1.482	1.703	2.052	2.473	2.771	3.421	3.690
1.056	1.313	1.480	1.701	2.048	2.468	2.764	3.409	3.674
1.055	1.311	1.479	1.699	2.045	2.463	2.757	3.397	3.660
1.055	1.310	1.477	1.697	2.042	2.458	2.750	3.386	3.646
1.050	1.303	1.468	1.684	2.021	2.424	2.705	3.307	3.551
1.047	1.299	1.462	1.676	2.009	2.404	2.678	3.262	3.496
1.045	1.296	1.458	1.671	2.000	2.391	2.661	3.232	3.460
1.044	1.294	1.456	1.667	1.994	2.381	2.648	3.211	3.435
1.043	1.292	1.453	1.664	1.990	2.374	2.639	3.196	3.417
1.042	1.291	1.452	1.662	1.987	2.369	2.632	3.184	3.402
1.042	1.290	1.451	1.660	1.984	2.365	2.626	3.174	3.391
1.036	1.282	1.440	1.645	1.960	2.327	2.576	3.091	3.291

It has become 99% confidence level. It has become 2.576. It is approximately we can consider it as 2.58. So, as it has become 2.58, then everything will get changed. So in that case, so this limit is same. But as it has become 2.58, so standard error will get changed. So, this is the maximum error maximum error is 0.196. It has become so standard error earlier was 0.1 and it has become 0.076 because of the fact earlier it was 1.96. Now it has become 2.58 so standard error is changed.

And in the same way, we can calculate the number of sample. So standard error 0.076 equal to 11 has come from this is the 1 standard deviation okay. And this is a standard error okay. And from there we can calculate the number under root in n = 13.16. And n has become 1.73. So what does it mean? Earlier if we test based on 100 data, 100 reading, then my confidence is 95% that means out of 100 data 5 will definitely go out there.

But if you want to higher confidence, if we need higher confidence in that case, we have to go for the large number of data that is 1.173. So, if we want to have more and more confidence, higher confidence, so in that case some number of samples will be more. Now this is one way of looking at. Suppose we will we will go back to earlier problem. Once again 95% confidence level ok, in that case I am not going to allow 1.96% here.

That is too much for me for our experiment this experiment needs very close limit okay. That is the wide limit in that. Now next example is that the same 95% is there. But here what we have done I am not allowing 1.96% of the error.

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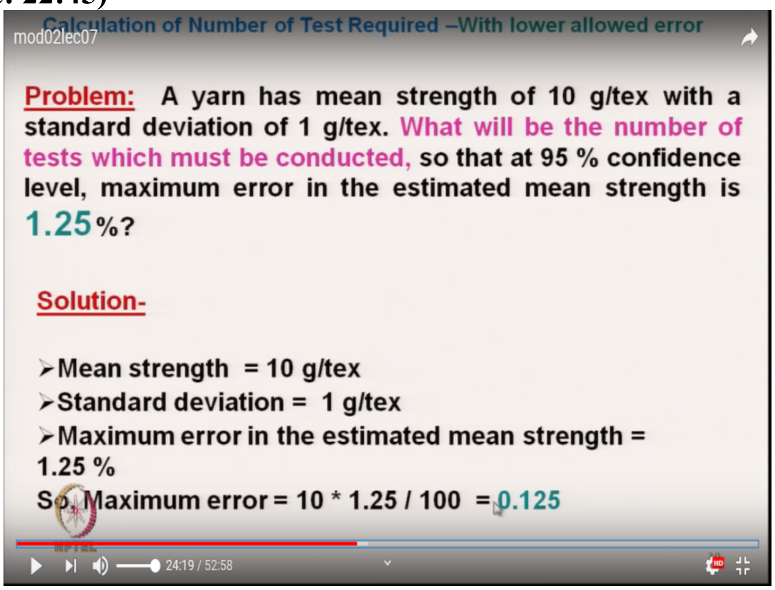

It is not allowed that is allowed only 1.25%, that is the error my experiment will allow because the number of amount of threat or amount of accuracy required or depending on the type of test okay. In that case suppose we want to test some material which that actual result will may give us the life threat like bullet proof vest the penetration efficiency is what in that case the error must be very, very small okay.

So, in that case so we so if we reduce the number of error then to have certain confidence what will be the number of data test required okay. So, from 1.96 we have reduced this to 1.25 okay. Now let us see the impact so mean strength is exactly same. Now standard deviation is same. Maximum error has got changed. 1.25 So, now we will calculate the maximum error. It has become. 0.125. Earlier it was 0.196.

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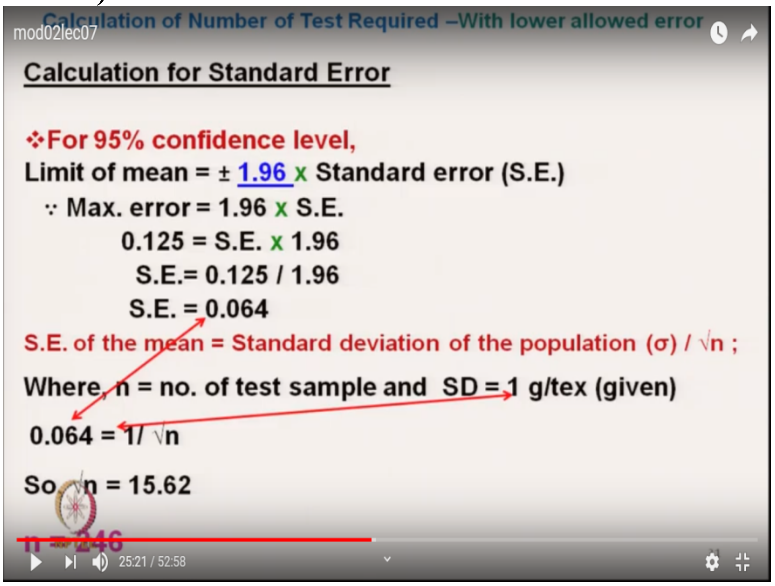

So confidence level is same. That is why it has become it remains that 1.96 okay. And standard error, from there we can calculate the standard error. So standard error will be 0.125 / 1.96 so standard error has become 0.064. This is the standard error okay. And if we know the standard error and our standard deviation is known. So we can calculate the number of sample. So this is the standard error. And standard deviation is given and we can calculate the number of sample.

And number of sample has become very high, 246. So, that as our requirement is becoming stringent. So, we have to take, we have to select large number of sample okay. So, we have seen here the number of sample depends on two parameters. One is that variability of sample or another level of confidence we require and the range error allowable, what is the error allowable. That is that we have to discuss. Now come to the next type of numerical, this is a value.

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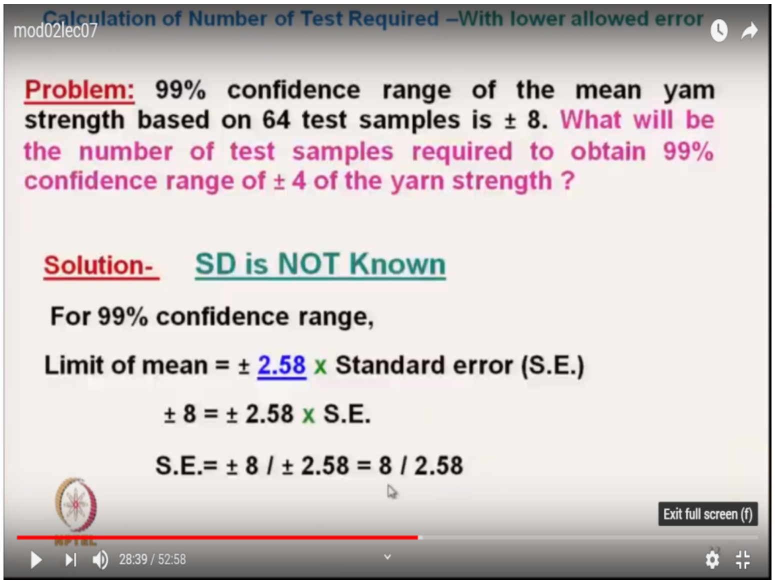

Now here calculation of number of test required with lower allowed error okay. So, at different number of allowed error here the thing is that we do not know the standard deviation. In earlier problem, the standard deviation was given. Here the one a little bit complexity is there. Here standard deviation is not given. So, we have to first calculate the standard deviation. The numerical is that 99% confidence range of the mean yarn strength based on 64 test sample is +- 8. Only we know the confidence range okay.

We do not know the even mean value. What will be the number of test samples required to obtain 99% confidence range of + - 4 of the yarn strength? So, confidence limit is same. So, 99% confidence limit is same. Only thing is that the range has changed. Initially 64 tests were conducted and confidence range was + - 8. Now we have reduced the confidence range okay. That is that has become +- 4. What we have done here? The error has been reduced.

We tried to reduce the error little bit. So standard deviation is not known here. So for 99% confidence range, the limit of mean, what is that? As it is 99% as we have seen earlier it will be t value is 2.58 multiplied by standard error. So, what is that limit here? +- 8 = 2.58 multiplied by standard error okay. And standard error will be +- 8 / +- 2.58. This is the value.

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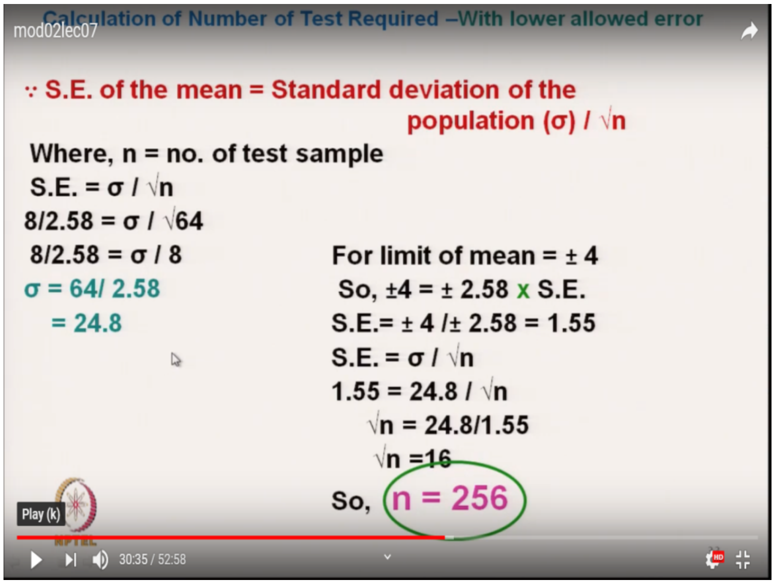

So standard error is 8/2.58 okay. This is the standard error of mean. So, standard error equal to standard deviation of population by under root n. So, n is the number of sample what is n value here it is a 64. So, n value is given 64. So, standard error is known, n is given. So, from there, 8 / 2.58 is the standard error 64 is given so from there we can calculate the Sigma. That is standard deviation of the sample. It is a standard deviation of population it is a 24.8.

So, now this standard deviation will use in the next segment second part. For limit of +- 4 so this is +- 4 again it has large sample 2.58. So from there standard error we have calculated it. So this is the 1.55 is the standard error. So, now we know the standard error. We know the mean population standard deviation standard error is known for this +-4 error. And standard deviation of population is known. So, from there we can calculate the n value.

So, this is the number of sample should be test taken to have the limit of +- 4, for same population. That means from +- 8 errors where we required only 64 test samples. When we are changing it to +- 4, the sample required, number of sample required 256 that means if we take 256 sample so with that 99% confidence level, confidence level, we can tell that the error will be maximum +- 8 okay.

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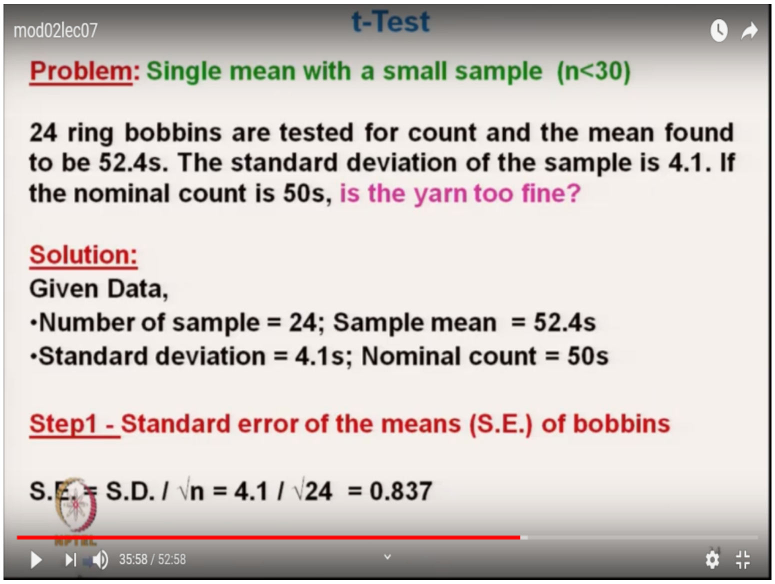

Now next problem is that we have, this is now the significance test, till now what we have done? We try to calculate the number of test required. Now this is the significance test which is single mean with a small sample. So, small sample typically we assume as less than 30 number of sample is there. If it is there it is a small sample. Now the problem is that the 24 ring bobbins are tested .We have tested 24 ring bobbins for count and the mean count is found to be 52.4, okay.

And the standard deviation of the sample is we have got 4.1. That is the standard deviation. And the nominal count of the yarn which is supposed to be 50. So, the targeted count is 50. But when sample is taken 24 ring Bobbins are taken and we have got the count of 52.4, with the standard deviation of 4.1. That is a sample standard deviation. Here population standard deviation is not known so in that case specific case we can assume the sample standard deviation, as population standard deviation because we do not have any data.

Now we have to tell that whether the yarn is too fine that this 50's count and it is 52.4 count. The question is that is the yarn is too fine should we take precautions, should we take any action, should we make it little bit coarser by changing the draft. So, all this question so suddenly changing draft it is not that easy. Suppose we have tested 24 ring Bobbin. We have got 52.4 suddenly based on that okay. This is coming final, 50 count is targeted, 52.4 count is coming.

So, before we take any action we cannot stop the machine we cannot stop halt everything so we that takes time. That is expensive one. Before that we have to quickly do the significance test. Significance test means if we do, if we assume, if we see that or if we can conclude that this difference is not significant then we let the process go. And this it will not have any significant impact on any other properties. But if this difference is actually significant then we have to stop.

We have to take the precaution okay. That is the basic reason of the significance test. So, now we have to decide whether the Yarn is actually finer or not. Now the solution is that what are the given data? The number of sample is 24 okay. And mean of sample is 52.4. That is the mean. Standard deviation is 4.1. That is the standard deviation and Nominal count is 50 that is a targeted count 50 that is that has to be produced.

But when we have tested sample, sample has come 52.4. Now how to do it? Here we have to do t test. So we have to calculate the t. And we know that how to calculate the t. To calculate the t we have to first calculate the standard error of the mean. So, standard error of the mean of Bobbin how to calculate the same formula standard deviation by under root n okay so, here standard deviation is known and number of bobbin is 24 samples.

So, standard error is calculated at the 0.837. Now if we calculate once we calculate standard error, then we can calculate the t-value what is t value?

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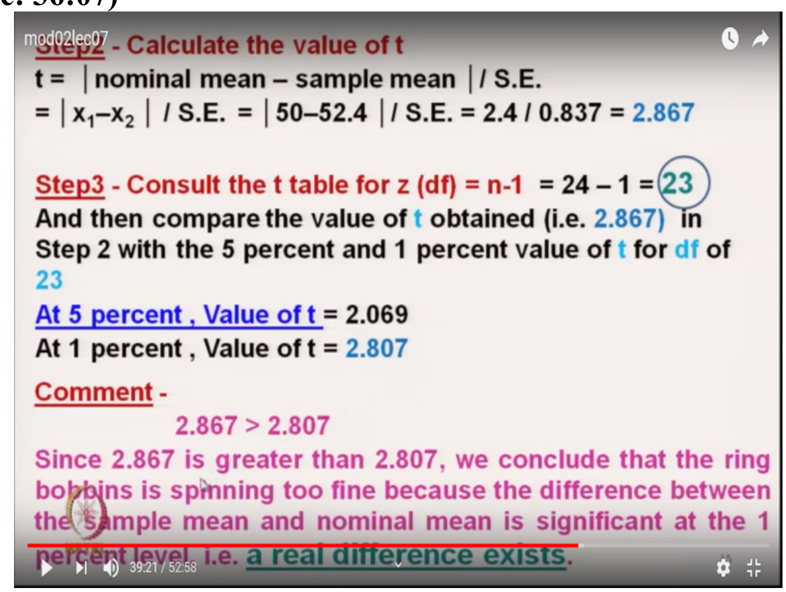

From earlier curves diagram we have seen that t is it is modulus of nominal mean minus sample mean by standard error okay. So, let us calculate the t-value. This is the t value 2.867 okay. So this is so 50 - 52.4 / standard error 2.4, by the standard error we have calculated. In last slide we have calculated 0.8367 so by .837 so, 2.837 is the t value. Now this t value we have to compare with the table t value.

For a particular degree of freedom that is it value which is nothing but n-1 number of sample minus1 we have 24 samples so degree of freedom has become 23. So, for that particular t value, particular degree of freedom from the table we can calculate we can get the t value so and then compare this t value obtained in the step 2 with the 5% and 1% value of t for degree of freedom of 23 okay. So, at 5% level the value of t is 2.069 and at 1% level value of t is 2.807. This is for the degree of freedom of 23. Let us see from the table

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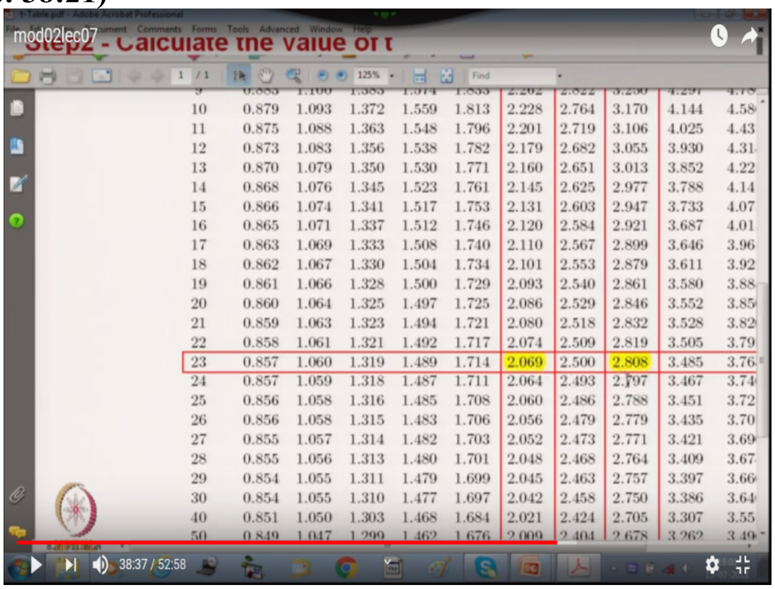

10	0.879	1.093	1.372	1.559	1.813	2.228	2.764	3.170	4.144	4.58
11	0.875	1.088	1.363	1.548	1.796	2.201	2.719	3.106	4.025	4.43
12	0.873	1.083	1.356	1.538	1.782	2.179	2.682	3.055	3.930	4.31
13	0.870	1.079	1.350	1.530	1.771	2.160	2.651	3.013	3.852	4.22
14	0.868	1.076	1.345	1.523	1.761	2.145	2.625	2.977	3.788	4.14
15	0.866	1.074	1.341	1.517	1.753	2.131	2.603	2.947	3.733	4.07
16	0.865	1.071	1.337	1.512	1.746	2.120	2.584	2.921	3.687	4.01
17	0.863	1.069	1.333	1.508	1.740	2.110	2.567	2.899	3.646	3.96
18	0.862	1.067	1.330	1.504	1.734	2.101	2.553	2.879	3.611	3.92
19	0.861	1.066	1.328	1.500	1.729	2.093	2.540	2.861	3.580	3.88
20	0.860	1.064	1.325	1.497	1.725	2.086	2.529	2.846	3.552	3.85
21	0.859	1.063	1.323	1.494	1.721	2.080	2.518	2.832	3.528	3.82
22	0.858	1.061	1.321	1.492	1.717	2.074	2.509	2.819	3.505	3.79
23	0.857	1.060	1.319	1.489	1.714	2.069	2.500	2.808	3.485	3.76
24	0.857	1.059	1.318	1.487	1.711	2.064	2.493	2.797	3.467	3.74
25	0.856	1.058	1.316	1.485	1.708	2.060	2.486	2.788	3.451	3.72
26	0.856	1.058	1.315	1.483	1.706	2.056	2.479	2.779	3.435	3.70
27	0.855	1.057	1.314	1.482	1.703	2.052	2.473	2.771	3.421	3.69
28	0.855	1.056	1.313	1.480	1.701	2.048	2.468	2.764	3.409	3.67
29	0.854	1.055	1.311	1.479	1.699	2.045	2.463	2.757	3.397	3.66
30	0.854	1.055	1.310	1.477	1.697	2.042	2.458	2.750	3.386	3.64
40	0.851	1.050	1.303	1.468	1.684	2.021	2.424	2.705	3.307	3.55
50	0.849	1.047	1.299	1.462	1.676	2.009	2.404	2.678	3.262	3.49

At 5% level will see the degree of freedom is 23 at 5% level this is a 95%. So, 95% level it is 2.069 ok and it is a 2.808. So this, with this two values we can compare the results okay. 2.069 and 2.807 these are taken from the table okay. And our calculated value is what we have achieved this 2.867. Now this 2.867 when we compare with this table value. It is higher than both this value, higher than 1% level.

That means what our conclusion is that that 2.867 is more than 2.1% at level 1% value is always higher than the 5% level, it is greater than 2.807. So, we conclude that the ring frame, ring bobbin is spinning so ring frame spinning too fine count okay. Because the difference between the sample mean and nominal mean is significant at the 1% level. So that real difference exist if it is there then what action we have to take, we have to stop the machine.

We have to stop the production we have to do the correction; we have to all the corrective action we have to take okay.

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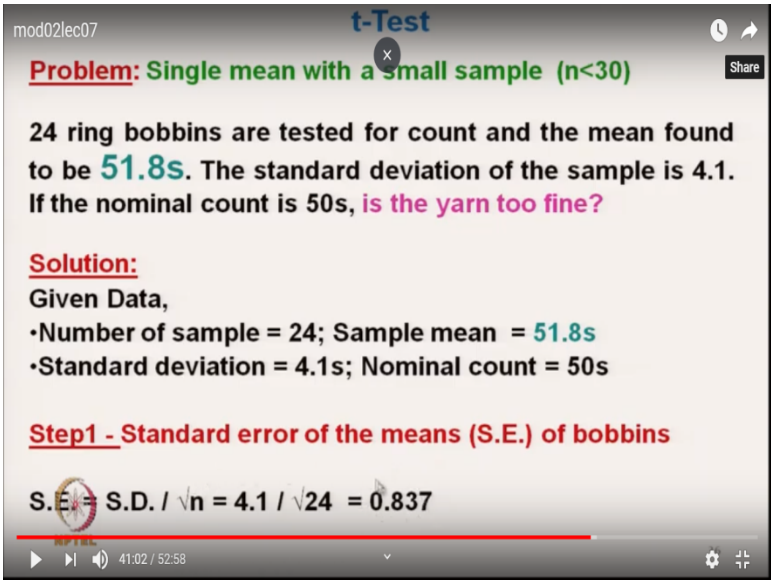

Now with the same data same problem we have to change here. What we have to change that 24 ring bobbins are there same ring bobbins are there. Now tested for count and mean is for to be 51.8 earlier it was higher. Now we have tested the count has become closer to the nominal value. Earlier if we see, earlier it was 52.4, okay. Now it has become 51.8 okay. Now we have to test, whether the yarn is still fine or not, okay. Same way we will go.

Number of sample mean is 51.8. Standard deviation is 4.1. It is given nominal account for same. Same step one. And standard error is same because the number of sample and the standard deviation was same.

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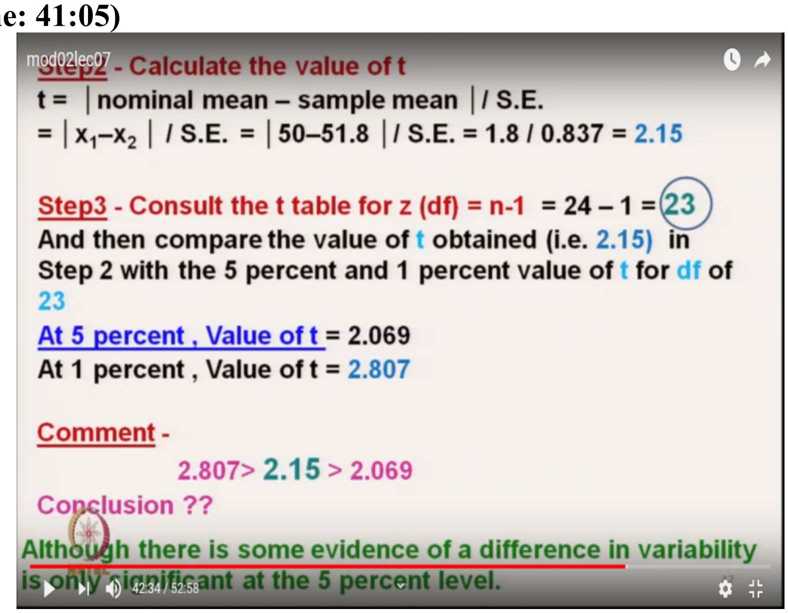

Only differences is that here the sample mean. Sample mean has become 51.8. So, the t value has become 2.15. And degree of freedom is 23. And for 2.15, 23, so it has at 5% level it was, 2.069

and at 1% level it is 2.807. So, our calculated value is 2.15. So, what does it mean? That is that means this value is lying in between 5% level and 1% level. That means although there is variation okay. But we cannot confidently tell that is a real variation okay.

So, this 2.807 is more than 2.15. So this is in between. The conclusion is that although there is some evidence of a difference in variability but only significant level at 5% level, so that depends on us, how to tackle this things, okay.

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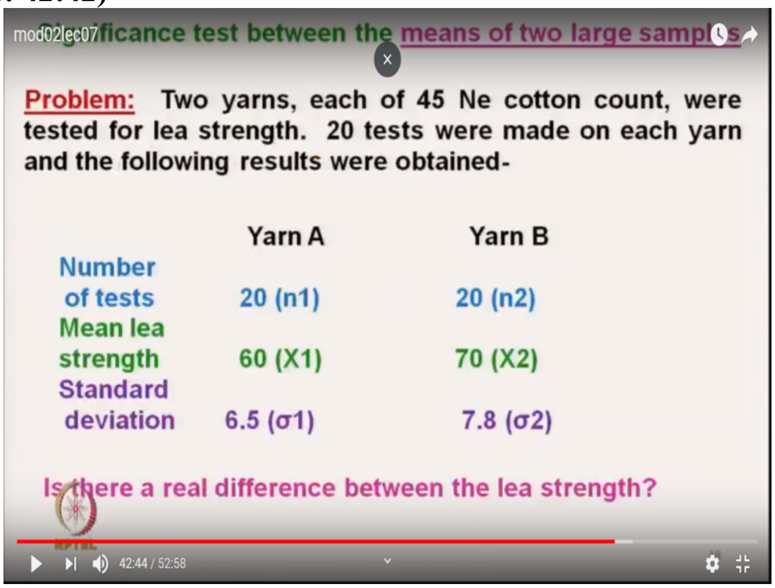

Now next is that significant test between means of two large samples. Now earlier, till now what we have done we have done? We have done significance test based on the nominal value. So nominal value is known our target, suppose ring frame is targeting as a 50's count targeting. So we have taken sample out of that. And we have done test on this. But this type of experience is very much required in the in research.

Where we have 2 samples 2 separate samples both the samples are there. In that case suppose we have selected one sample, sample of yarn A. Another sample we have taken sample of yarn B. Now we would like to compare these two samples. When we try to compare the two individual samples for the significance then we have to test, we have to use some different methods. Now let us see this example.

From this example, it will be very clear now two yarn each of 45 any count, okay 45 any count is known, where this were tested for lea strength. 20 tests were made on each yarn. And the following results were obtained. So, yarn A 20 test, yarn B 20 test. Mean strength here is 60. 60

pound okay. And here it is a 70. Mean strength and standard deviation here is a Sigma 1 is 6.5 and here Sigma 2 is 7.8.

Now what we are interested in whether this 60 and 70 whether the yarn B is significantly stronger than yarn A? Or yarn A is significantly weaker than yarn B? That we have to test, so, do you right way reject yarn A? So, that we have to test okay. Suppose we have two samples, two samples from to supply yarn A and yarn B. We have to select one of them okay. Now suppose this yarn A is giving little bit cheaper price yarn A.

Then suppose the prices are same, then we will definitely go by this yarn B. But yarn A when they are offering us some discount then we have to take the decision. But at the same time it is said that we cannot compromise our strength okay. Now what we have to do we have to the option with us if that before taking finalisation before rejection we can take one chance. Because we cannot compromise with the strength so we can reject.

But before rejection we will do some test significant test. Now if the significant test says, this difference is significant then we will reject it. If it is insignificant then we may decide to take this one okay.

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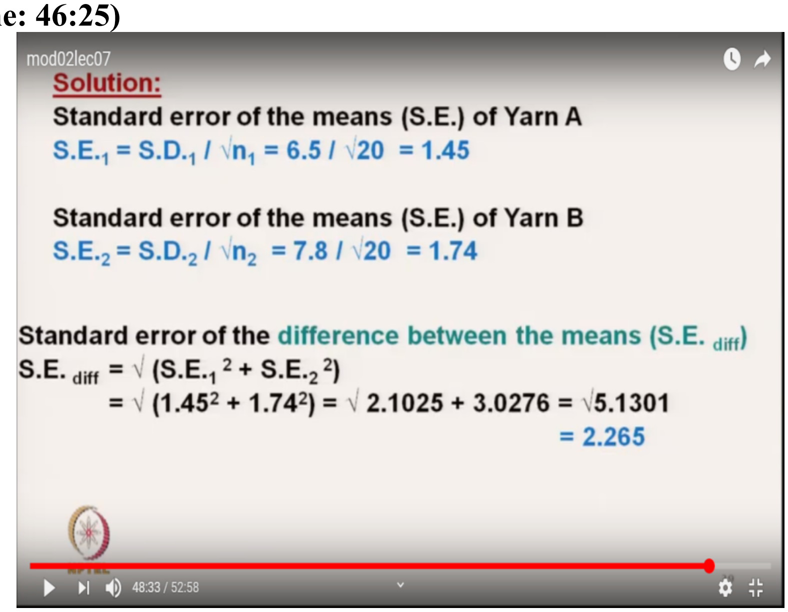

Now what we do standard error of mean of yarn A. So, like earlier processes we will calculate the standard error of yarn A, SE1 same way 6.5 by under root 2. This is the standard error of yarn A. Similarly for yarn B standard error 2 is equal to 1.75. Now what we are doing here we are trying to calculate the significance of the difference of mean. So, in that case we have to calculate the standard area of difference of mean.

So, it is not the standard error of mean. Because our target is that to test the significance difference of mean. So, the from Standard error of 1 and standard error of 2, we can calculate the standard error of the difference between the means which is known as SE difference okay. And choosing a simple formula is the standard formula given. So from SE1 and SE2 what we do we calculate SE difference, okay.

So, what is the formula under the root of SE1 square + SE2 square okay and SE1 and SE2 is known. So, from there we calculate the standard error of difference okay. Now this standard error will be treated as normal standard error, as we have done earlier okay. But here as we have 2 standard error and we want to calculate the we want to understand the difference we have to take the decision on the difference in mean that is why we have to calculate the standard error of difference okay. SE difference has become 2.265. And this 2.265 is the standard error of difference.

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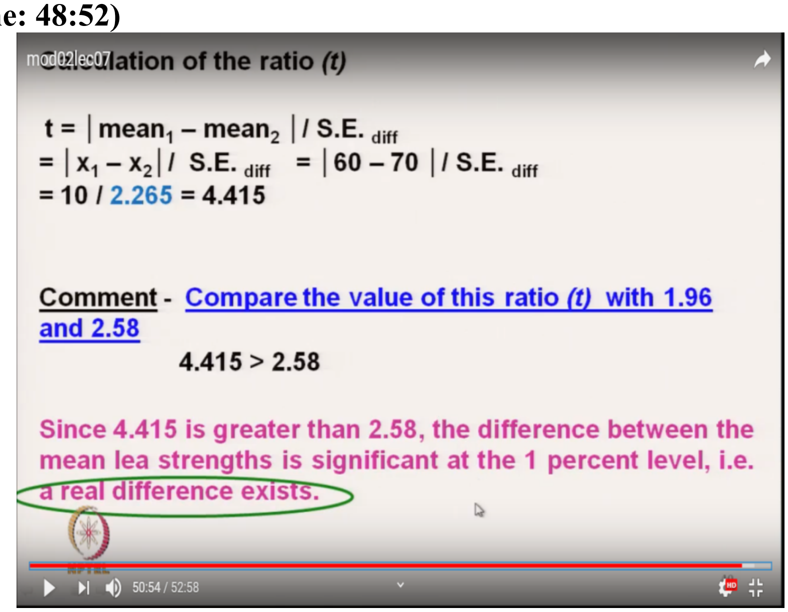

And then we will use we will treat exactly in the same way. Here only thing difference is it here earlier case we have to use the standard error. But here we are using standard error of difference by the same way. Because here we have two individual mean okay. Now t is 60 - 70 / standard error difference. We know the standard error of difference is 2.265. So t value has become 4.415.

So, this is the t value and our degree of freedom was that is a large sample. So, for large sample it is the for 95 and 99% it is 1.96 and 2.58 as we have seen earlier also. And this is for both it is very high. Okay. The t value is very high that means what will be our conclusion? Our conclusion will be there is a real difference is there. Since 4.415 is > 2.58 the difference between the mean lea strength is significance at 1% level. That is a real difference exists.

So, in that case in this case what our decisions would be, we must reject that one yarn A which is of 60strength okay. Yarn A we can reject and we can retain the yarn B okay. So, this is what about the significance difference in mean okay.

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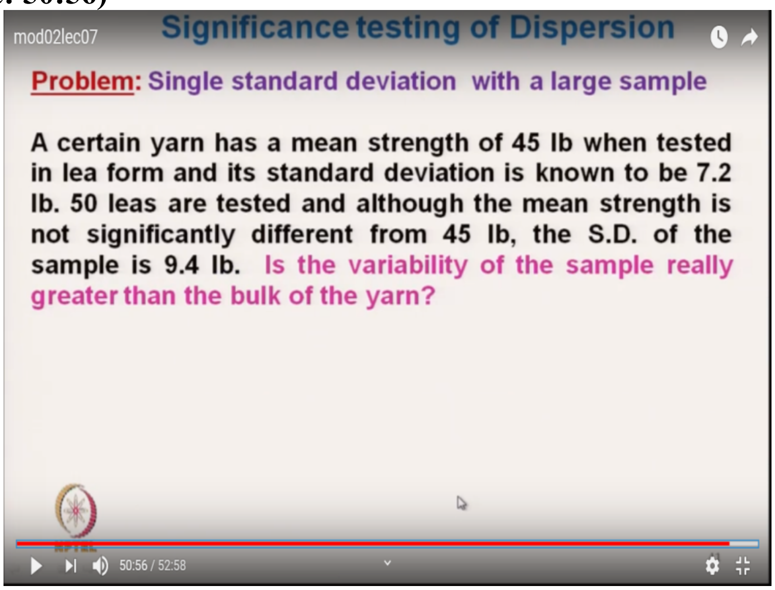

And next segment real difference is there in next segment we will discuss the significance testing of dispersion okay. So significance of testing of dispersion is of basically the problem is here. The mean difference is there mean difference there is no difference suppose the mean earlier till now what we are have seen the yarn there is which is weaker or which is stronger or which is more variable So that is the mean value.

And difference we are trying to understand and if there is any significant difference is mean value. Then we are taking proper action so like last problem last numerical what we have seen, where the weaker yarn which is that is 60 pound the strength, we have rejected straight away okay. Now here in the significant testing dispersion, what we will discuss here. Supposed two sample in one sample the variability is high and another is variability is low.

So, in that case should we which sample should we take? With higher value variability that means always it is not desirable to have higher variability but if the machine is producing higher variability should we take immediate action or not? That all things we will discuss we will discuss in the next class okay. Till then Thank You.