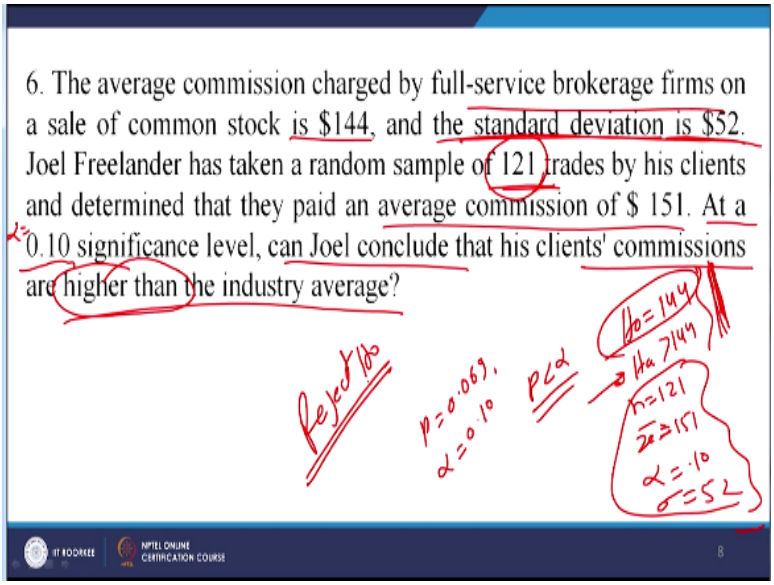
Business Statistics
Prof. M. K. Barua
Department of Management Studies
Indian Institute of Technology – Roorkee

Lecture - 38
Hypothesis Testing of Proportion using Minitab

Hello friends, I welcome you all in this session. As you are aware in previous session we were solving couple of examples of 1-Sample Z test questions using Minitab, and we have worked out several examples. But, in all those examples which we worked out in last session and we were having only z-test, we used only z-test. We did not work out any example using t-test. So let us look at couple of more examples using Minitab and we will work out examples not only on mean but on proportion as well. So let us look at this example.

(Refer Slide Time: 01:11)



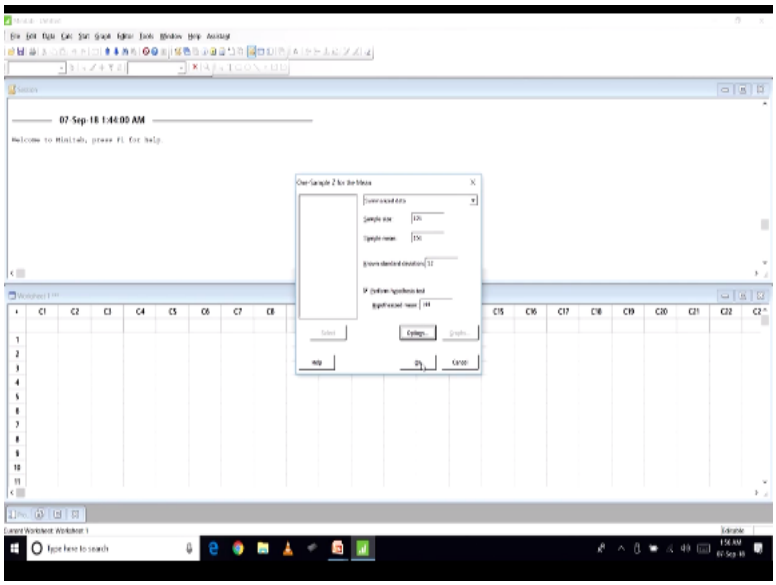
The average commission charged by full-service breakage firms on a sale of common stock is this, so average commission is $144, right, and the standard deviation is $52. Joel Freelander has taken a random sample of 121 trades by his clients and determined that they paid on an average a commission of $151. At a 0.10 significance level, at this much alpha level can Joel conclude that his clients' commissions are higher than the industry average?

Just last line, can Joel conclude that his clients' commissions are higher than, right the industry average. So how would you proceed for this? This is the case of what, 1-Sample test or 2-Sample

test, so first of all let us frame null hypothesis and alternative hypothesis. So null hypothesis is this that the average brokerage is 144 and alternative hypothesis is that this is more than 144, so this is how you should frame null and alternative hypothesis.

Now, sample size is what? 121, right n=121 traders, determine that the average commission of this so x bar is sample mean is 151, right. At alpha=0.10. Now we need standard deviation here, so you have been given a standard deviation as well right, so standard deviation is 52. So this is a case of one tail, upper tail test are right tail test with this set of information. So we will work out this question and we will see whether we would be rejecting or not rejecting null hypothesis. So let us look at this.

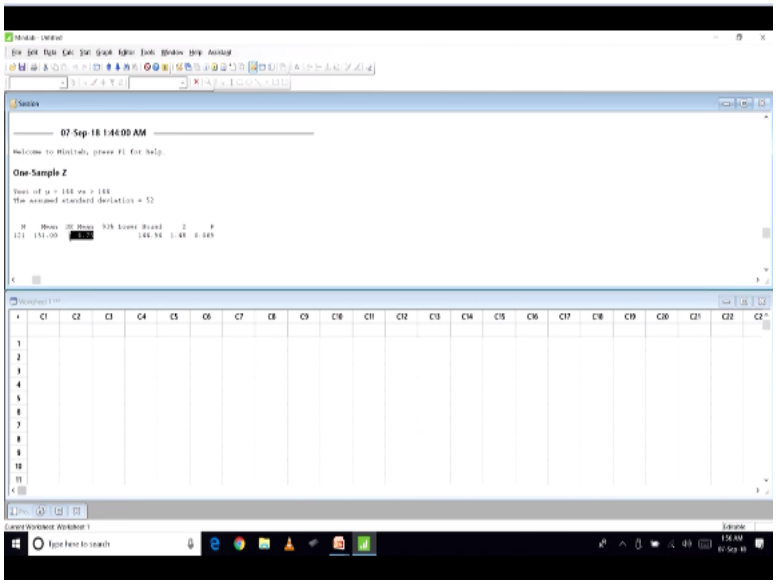
(Refer Slide Time: 03:44)



So first of all, go to Stat, Basic Statistics then 1-Sample Z test then we will have Summarized data, so this summarized data, sample size is there let us look at, sample size, it is 121, sample mean is 151, so 121 is sample size, sample mean is 151; we have been given alpha as 0.10, standard deviation is there which is 52; perform hypothesis testing so we will click here, hypothesized mean is, let us check once again, what is hypothesized mean? 144 is hypothesized mean.

Let us decide a significance level, alpha value so just click option, confidence level is 95, so it is 90 in this case because alpha is 0.10 then alternative hypotheses would be > type, right. So then click OK.

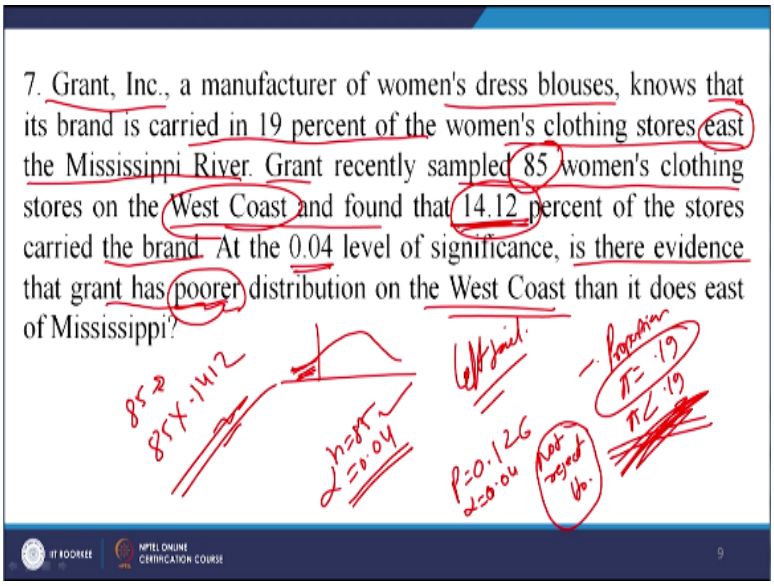
(Refer Slide Time: 05:15)



So this is your sample size mean, standard error and this is your P value, right. So P value is 0.69 and alpha is what 10. So is P < alpha? Yes. P is < alpha so we will reject null hypothesis and then we will say that; when we reject null hypothesis it means, it means we are accepting alternative; it means that we can say that John conclude that his client commission are higher than industry average, yes. Client's commissions are actually higher than industry average.

This is the decision, right when you rejected null hypothesis. So this is how you can work out questions on hypothesis testing using Minitab. Let us look at question on hypothesis testing of proportion.

(Refer Slide Time: 06:36)

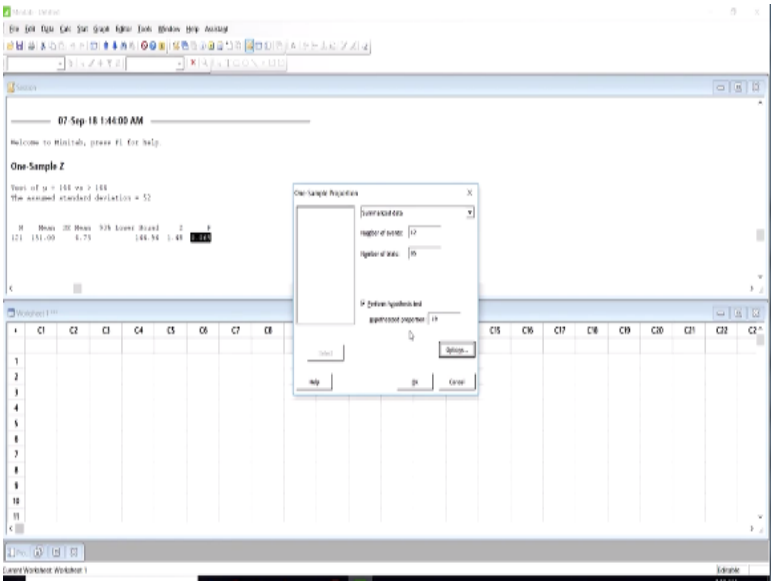


So Grant, Inc., a manufacturer of women's dress blouses, knows that its brand carrying 19% of the women's clothing stores east the Mississippi River. Now, he recently sampled 85 women's clothing stores on West Coast and found that 14.12% of these stores carried the brand. So it is 19% east of the river and 14% on West Coast, 14.12%. At a 0.4 level of significance is there evidence that Grant has poorer distribution on the West Coast than it does on east coast, right?

So how would you frame null and alternative hypothesis? So first of all keep in mind this is not an example on hypothesis testing of means but it is a case of hypothesis testing of proportion, right. So what would be the null hypothesis? So initially you will say that the distribution is equal on west coast and east coast, right. So you will frame null hypothesis like let us say pi=0.19, right. And pi is < 0.19. Is not it?

So this is a case of left tail test. Is not it? So it would be like this, right. So this is here rejection region, right. Let us look at other details given in this question. So we have got sample size n=85; alpha=0.04, okay. So let us work out this example using Minitab, right. So keep in mind, 85 is the sample size, alpha is 0.4 it means 96%, right. Okay, so we will look at how to enter data.

(Refer Slide Time: 09:22)



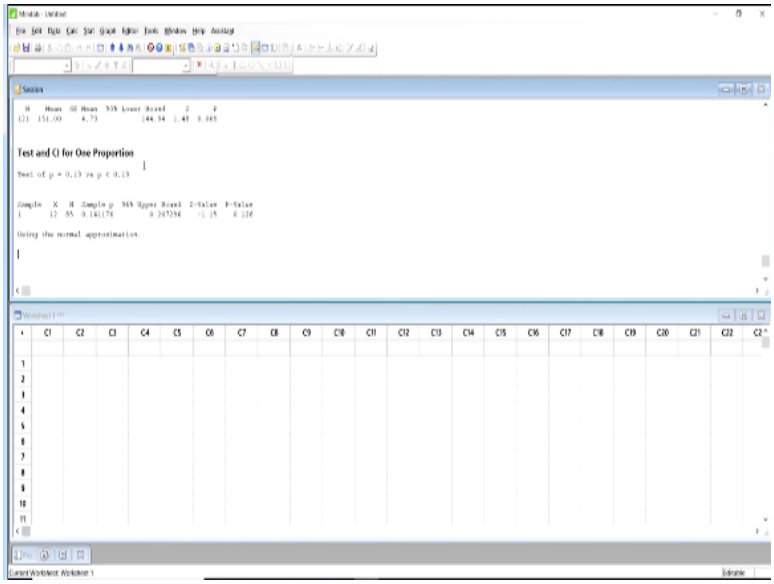
So we will go to Stat, Basic Statistics this is 1-t test, yeah this is 1-P test, one proportion this is the case of proportion right so 1-P. We will click here and this is how you can enter data either you can enter data in each column or you can have a summarized data. So this is a case of summarized data, so we will enter data over here. So here we will have to write number of events and number of trials. So let us look at question again number of events and number of trials, right.

So Grant recently sampled 85 women's clothing stores on West Coast and found this much percent, it means out of 85 how many samples were there, so you just multiply 85*0.1412, you will get some value. So that would be, that would be total events, right. A number of trials are nothing but sample size. So you can just calculate this value you will get some answer, so let us do data entry. So whatever is that value we will enter that value in Minitab software.

So number of events is 12, right. So when you multiplied 85 and 0.142 the value was 12, right approximately 12, right, because you cannot write any decimal points over here. So number of trials you just enter that value it is sample size, right. Then, we will perform hypothesis testing. Hypothesized proportion in this case is you know it, it is 0.19. Is not it? So 0.19 is hypothesized proportion.

We will go to options and confidence level is 96%. Is not I, because alpha was 0.4. And this is case of what type test, this one is a left tail test, right < type test. So alternative hypothesis proportion is < hypothesized proportion, and there are two methods given Exact method and Normal Approximation so we will use Normal Approximation then click, one more click here, right.

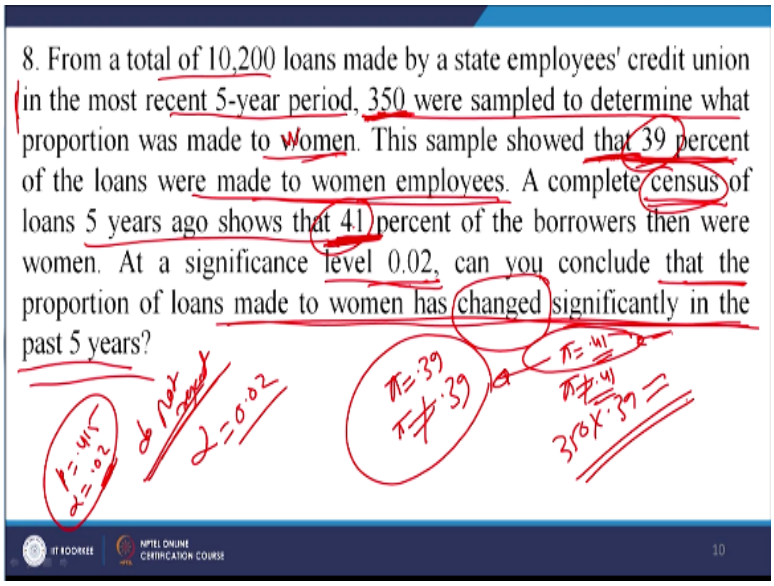
(Refer Slide Time: 12:31)



So this is the output. So we have got sample size 85, sample proportion is this much. You have got upper bound as well and Z value but let us look at P value is 0.126; 0.126 is P value right. And alpha value is 0.4. Is P value < alpha? Is P < alpha? No. So we will not reject null hypothesis. We will not reject null hypothesis it means what, will accept it, is not it? And what is this hypothesis that the distribution of this particular brand of clothing is same both sides, east coast and west coast, this is the conclusion. Okay.

So this is how you can solve a question on hypothesis testing of proportion. Let us look at one more question.

(Refer Slide Time: 13:51)



From a total of 10,200 loans made by a state employees' credit union in the most recent 5-year period, 350 were sampled to determine what proportion was made to women. This sample showed that 39% of the loans were made to women employees. So out of 350 women surveyed 39% were given loans. So out of this much trial, you have to find out number of you know, what is that it is the number events, right.

So this is 350*0.39, right that you will be entering data in Minitab software, right. So this sample showed that 39% of the loans were made to women employees. A complete census of loans 5 years ago showed that 41% of the borrowers them were women. So a complete census was done 5 years before this particular study and the results were that 41% loan was given to; 41% women were given loans right, at a significance level of 0.2.

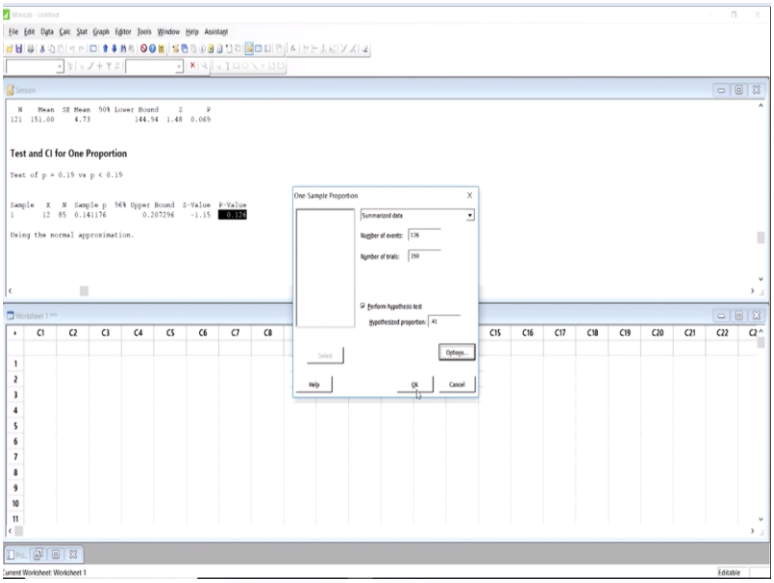
Can you conclude that the proportion of loans made to women has changed significantly in past 5 years? So when you did a survey and found that 39% women were given loan but in another study which was done 5 years ago showed 41% were given loans, right. So can we conclude that the proportion of loans made to women has changed significantly in past 5 years? Here we have to see whether it have changed significantly or not, right.

You do not have to check whether it is increased significantly or decreased significantly, especially increased significantly, right. So how would you frame null and alternative

hypothesis? Your null hypothesis would be 0.39 and alternative hypothesis is not equal to 0.39, so it is case of two tail test. Okay. In fact, so this is in fact this is the study which has been done now and it was earlier study, so we have to check there is a change from previous study to this study or not.

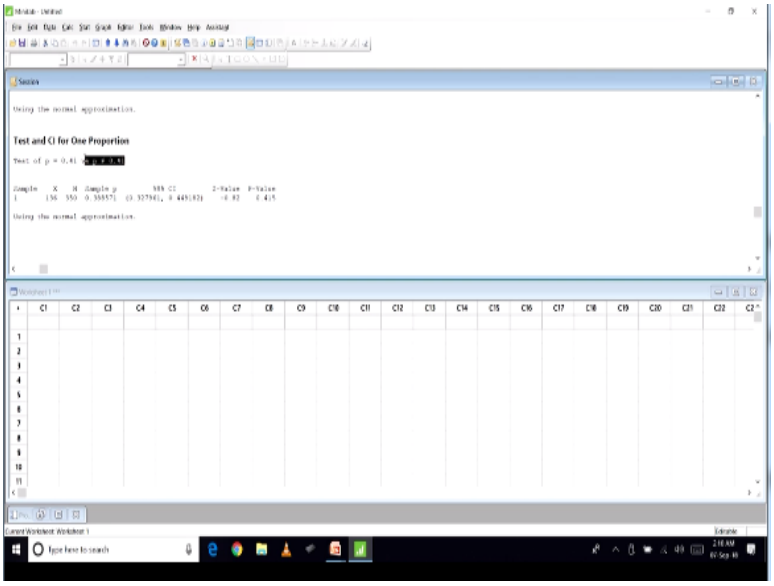
So in fact this is not the way you should be writing null and alternative hypothesis. In fact, what you should be writing is pi=0.41 and alternative hypothesis is not equal to 0.41. Right. So how to proceed for this now? Let us look at other data. Here sample size is 350 and significance level is 0.02. So let us look at solution using Minitab.

(Refer Slide Time: 17:49)



Stat, Basic Statistics, it is 1 P, right, number of events, so you need to multiply 350*0.39 right so it becomes approximately 136. And number of trials you need to write total sample size, right. So it was 350, okay. So perform hypothesis test, hypothesized proportion is now 0.41, right. Options, so this is; it was 0.02, so 98% significance level and this is not equal to because we do not have to see whether the percentage loan given to women has gone down, is not it? We have to just see whether it is changed or not. Then press, OK, then click OK.

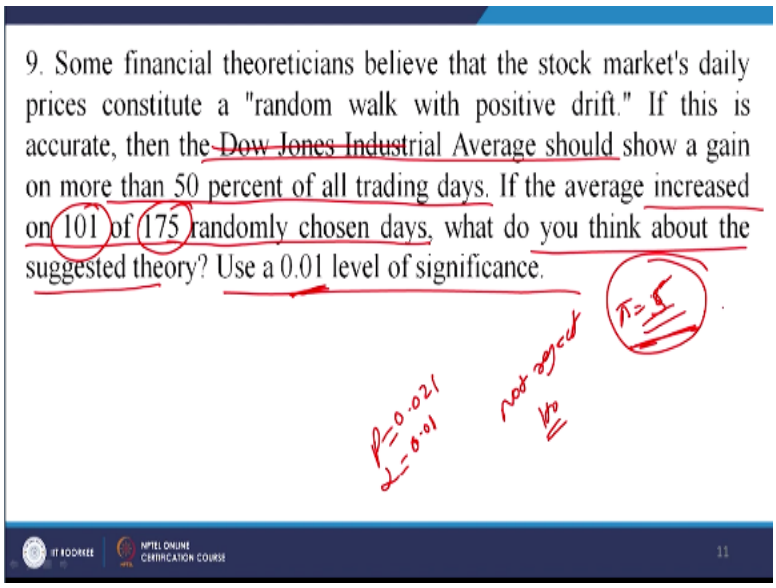
(Refer Slide Time: 18:58)



So P value is 0.415 and other values are given over here, this is the null hypothesis, this is alternative hypothesis, right, so 0.415. So P value is 0.415. And alpha=0.02. Is P < alpha? No. If P is < alpha, no, so we will reject the null hypothesis. So we will not reject the null hypothesis. If P is < alpha, reject the hypothesis otherwise do not reject the hypothesis. So we will not reject null hypothesis, it means this hypothesis still prevails, right.

It means what we are saying is that there is no change in the percentage of loan given to women now and what it was 5 years ago, right. So it is just statistically it is one and the same. Let us look at next question.

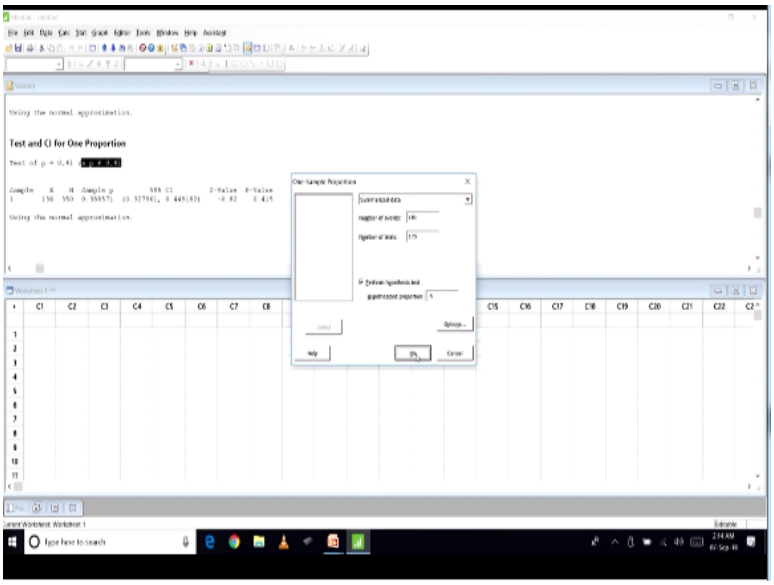
(Refer Slide Time: 20:25)



Some financial theoreticians believe that the stock markets daily prices constitute a random walk with positive drift. If this is accurate, if this is accurate then the Dow Jones Industrial Average should show a gain more than 50% of all trading days. If the average increased on 101 of 175 randomly chosen days, what do you think about the suggested theory?

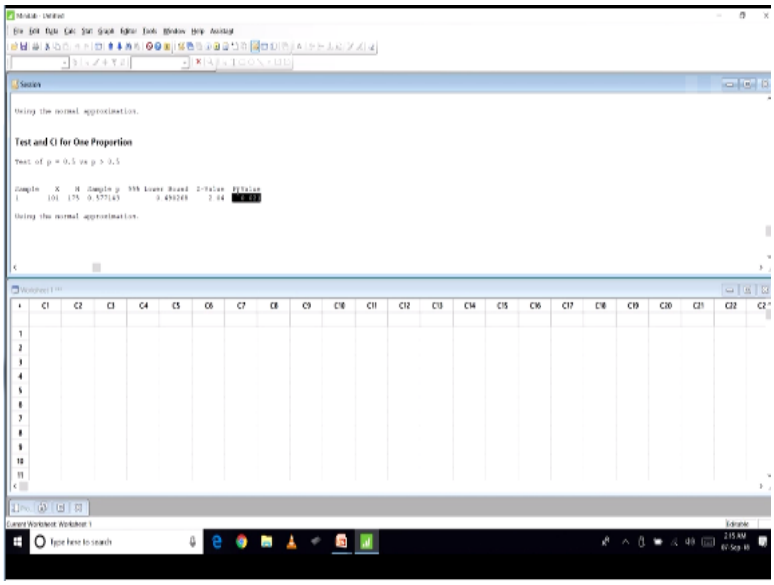
Use 0.01 level of significance. So this is a case wherein you have been given sample size, so number of events and number of trails are given over here. So this is a case wherein you need to a frame null and alternative. So null hypothesis is it is pi=0.5 average should go should show a gain of on more than 0.5 of all trading days if the average increased on; so let us work out this question and we will do data entry.

(Refer Slide Time: 22:08)



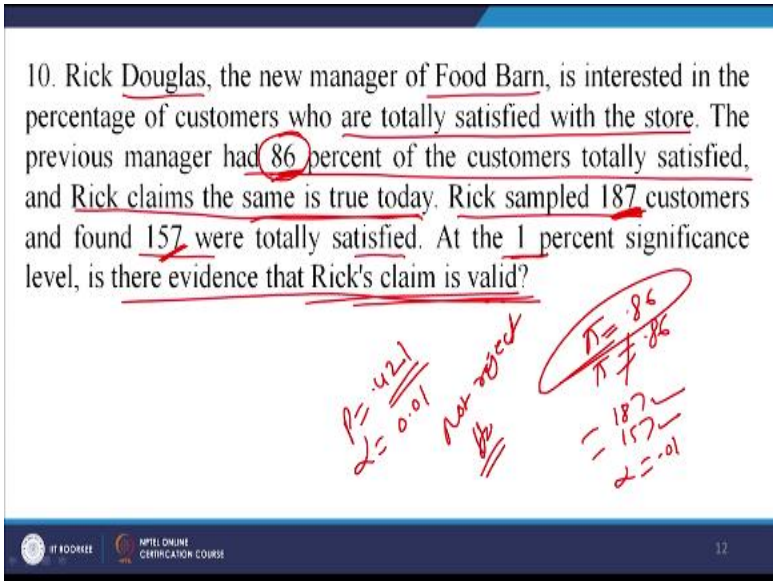
So go to Stat, so number of events 101 and number of trials, number of trials 175. Perform hypothesis test, so hypothesized proportion is 0.5 options; you need to test this hypothesis, let us look at this 0.18 means 99%. Okay. So this is how; just select hypothesis which is > type, click OK, click OK.

(Refer Slide Time: 23:12)



So look at P value over here, P value is 0.21. So this is a case of an upper tail test or right tail test. We will have, we can compare P value with alpha value. So P is 0.021 and alpha is equal to is P < alpha? No. So we will not reject null hypothesis. And what is null hypothesis that the average is 50% of all trading days. It is not increased. Okay. So let us look at next question.

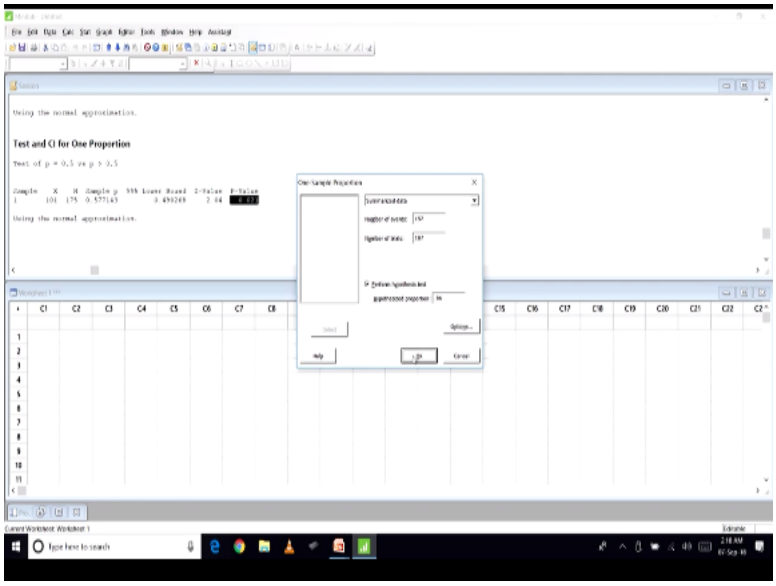
(Refer Slide Time: 24:13)



Rick Douglas, the new manager of Food Barn, is interested in the percentage of customers who are totally satisfied with the store. The previous manager had 86% of the customers totally satisfied, and Rick claims the same is true. So there was this fellow, there was one manager who did a survey and he found 86% customers were satisfied and this manager also believes the same.

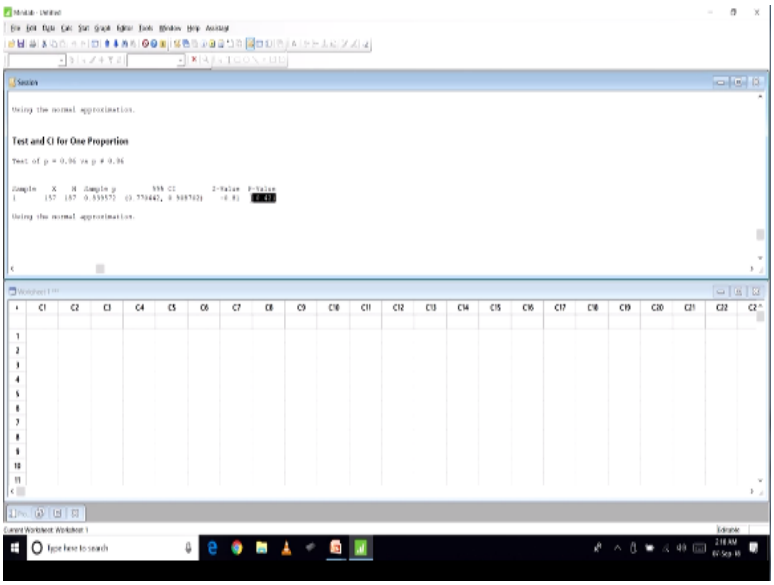
Now, he sampled 187 customers and found 157 were totally satisfied. At 1% significance level, is there evidence that Rick's claim is valid. So is this percentage still valid? So your proportion is 0.86 and it is not equal to 0.86, total sample size or let us say total trials are 187 and number of events are 157, right. And alpha=0.1. Okay. So let us look at this.

(Refer Slide Time: 25:49)



We will go to stat, 1 Proportion, number of events 127 and number of trials, will check it, it is 157 and 187 and number of trials 187. We will perform a hypothesis testing. Let us look at once again, hypothesized mean, it is; hypothesized means hypothesized proportion 0.86. Click Options, then yes this correct, it is 99% and proportion is not equal to; hypothesized proportion is not equal to, click OK, click OK, right.

(Refer Slide Time: 26:58)



So P value is 0.421. Now, let us look at whether we are rejecting or not rejecting null hypothesis. 0.421, so P value is 0.421. And what is alpha value? 0.01. So is P < alpha? No. So we will not reject null hypothesis. And we will say that, Rick's claim still valid. Whatever was satisfaction level of customers 86% earlier it is still the same, it is not increased or; it has not changed. In fact, we really do not know whether it is increased or decreased.

In fact, that can be known from here just when you divide 157/187, if it is more than 86% then we will say it is increased otherwise; if it < 86% you will say it is decreased, right. But for the time being we will say that there is no change in satisfaction level. So let me summarize what we have done in today's session. We have looked at couple of questions on hypothesis testing of proportion especially 1-Sample test.

And we have looked at in fact, one tail test as well two tail test. In next session, we will have questions on t-test. In fact, I really do not know whether we have taken couple of examples on 1-Sample t-test or not. If we have not taken, we will have some questions on 1-Sample t-test. So with this let me windup today's session. In next session we will have some more questions on hypothesis testing of proportion using Minitab. Thank you.