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Since the last clip, I showed you the mechanics of hypothesis testing, and we did an example. Let me do another example just to make sure we are all on the same page about how to test a hypothesis. So this is an example where we are working with proportions. Okay. So let's suppose we want to test the hypothesis that ads have an impact on perceptions about politicians. So what would be an example of this? So let's say there is a politician, think about your current prime minister or the government or someone public figure whose current favorable perception among the population is, let's say, 40%, or point four. Right? So this politician now runs an ad campaign. And after the ad campaign, they survey 200 people and find 90 of them now have a favorable perception, right, 90 out of 200. So question is, does this support the hypothesis that ads have an impact on perceptions about politicians or doesn't? So remember, first thing, we need to set up the null hypothesis and alternate hypothesis. And as I've said before, the null hypothesis is the skeptics view, right, the skeptics view is that ads don't have an impact on perceptions. So what even the fact that you ran an ad campaign, that should not change the current perception of point four for that. So the null hypothesis here is that μ naught is equal to point four versus the alternate hypothesis that μ naught is not equal to 0.4. So now, we have to check whether what we found from the survey, right, that 90 out of 200 people have a favorable perception. Does this support this hypothesis? Ah not or do we reject it in favor of this hypothesis? Sooner data like this, right? So remember, the underlying variable here is categorical. Right? So every person you asked whether you have a favorable opinion, or no, right, the answer yes or no. So in this case, your estimate is the proportion, right, so in this case, the P is going to be 90 over 200. So that's equal to point four five. For this, remember, and this is what we did earlier, the standard error is going to be $\sqrt{P(1-P)}$. Sorry, the standard deviation is going to be square root of $P(1-P)$. And if you do that here, it's going to be point four five, that's this p, right? times one minus p, that's point four five. And if you use your calculator, this will come turn out to be point four five. Now the next step, again, thinking back to the mechanics, right, so we are p equal to point four five s equal to point four five. Right, we need to construct the Z-statistic. So in this case, the P is point four five, right? So that statistic is $\frac{p - \mu_0}{\sqrt{p(1-p)}}$. So mute zero here is point four, right? So that's the null hypothesis. If the null hypothesis were true, then μ_0 would be point four, right? divided by s, which is point four five, divided by the square root of the number

of people surveyed. That's 200. And if you use a calculator to compute this, this turns out to be 1.42. So this is our test statistic. And now if we want to check whether we want to reject this hypothesis or not reject the null hypothesis. Right? We need to check this 1.422 against this interval negative 1.96 to 1.96. Right? So those are your critical points. And now you see that this test statistic actually lies within that interval. So therefore, based on this data, you cannot reject the null hypothesis and the other, in other words, read going back to the hypothesis that we're testing, what we can say is that based on this data, right, we cannot reject the hypothesis that ads don't have any impact on perceptions. Right, we do not have enough evidence to support this particular hypothesis that ads actually have an impact on perceptions about politicians, right? So in this case, right, it's based on this particular data that we have, right, we cannot reject the hypothesis that there is no change in perceptions after the ad campaign. So this is another example of doing the Mechanics of hypothesis testing. But this time with a categorical variable, we are talking about proportions. The mechanics is all the same. The only thing that changes here is that we can compute the standard deviation using this formula, which is square root of p times one minus p . Well, let me end this clip with one other aspect of hypothesis testing that gets talked about a lot when you talk about hypothesis testing, this is called P values. Now, suppose you come up with with a Z -statistic, this. They asked the question, what is the probability of seeing extreme data like this in either direction, given that your null hypothesis is true? So remember, in the we started out by looking at okay, if the value is below negative 1.96, or above 1.96, right, we would be rejecting the null hypothesis. Now suppose we flip the question and ask the following, right? Suppose we come up with a Z here. Suppose given that the null hypothesis is true? What's the probability of seeing data? This Z or below? Or the Z or above? If the null hypothesis is true, then that probability should be high. And on the other hand, if the null hypothesis is false, right, then you would expect that that probability should be small. Right? So the p value exactly gives you what's the probability of seeing extreme data like this, given that each notice true. So again, coming back, right, so you have come up with a Z right? Now you're asking, what's the probability of seeing extreme values like this, or like this, given that H_0 is true? Right? So this is a conditional probability. So conditional on H_0 , what's the probability of seeing extreme values like this? Right? So if that probability is small, then we're going to reject the null hypothesis because that means it's very unlikely that this is going to happen if H_0 were true, right? So what we do is that we reject H_0 if the p value is small. So typically, if it's less than 5%, we reject the null hypothesis. So let's go back to our ad campaign example, right where we were testing whether the perception is unchanged from point four. So we got p equal to 0.45. And we got the Z statistic of 1.42. Right? And now suppose we want to compute the p value. So what we want to compute is what's the possibility that the Z can take values less than negative point four or greater than point 1.4? Right? Remember this right? What's the probability of getting values less than this? Right? or higher than this? So that's called the p value, right? And this is conditional on the H_0 not being true. Right? So this is a conditional probability. Now, how do you compute this? So remember, the normal distribution is nice and symmetric, right? So whatever is the probability here, right? It will be the same probability here, because it's, it looks the same, it's bell shaped. So it's the same this way. And that way, one side is the mirror image of that, right? So all we need to do is if we can compute this probability, then the, this whole thing will just be twice that. And what do I do to compute this? Now I go back, if I go back to my probability modules for I showed you how using Excel using this norm dot distribution, you can actually figure out this probability for a normal distribution. And this turns out to be 0.078 in this particular case, right? So the p value will be twice that so twice 0.0778. Right, so that'll be point 1556. And see this p value is greater than 0.05. Right? What it says is that the probability of seeing a Z value like this, right, or lower, right is actually 15%. Right? Which is bigger, which is not that small, right? Is not as small as the 1% or 2%, or 5%. Right? So in this case, we cannot reject the null hypothesis, because it's

very much possible that even with when when the null hypothesis is true, right? The probability that this sort of data occurs is about 15%. Right? So that probability is not that small, so we cannot reject. Ah. So what I've shown you is that two ways of doing hypothesis testing, either just looking at the Z-statistic and comparing it with whether it lies in that interval, negative 1.96 to positive 1.96, or not, right, or by computing the p value, and looking at whether that's less than 5% or greater than 5%. Those are equivalent, but you see both of them talked about in your statistics classes, and in papers and in social sciences a lot so I thought I should mention the p value as well. So let's stop the clip.