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Course > Inference: Hypothesis Testing for the Population Proportion > z-test for the Population Proportion > Learn By Doing Activity

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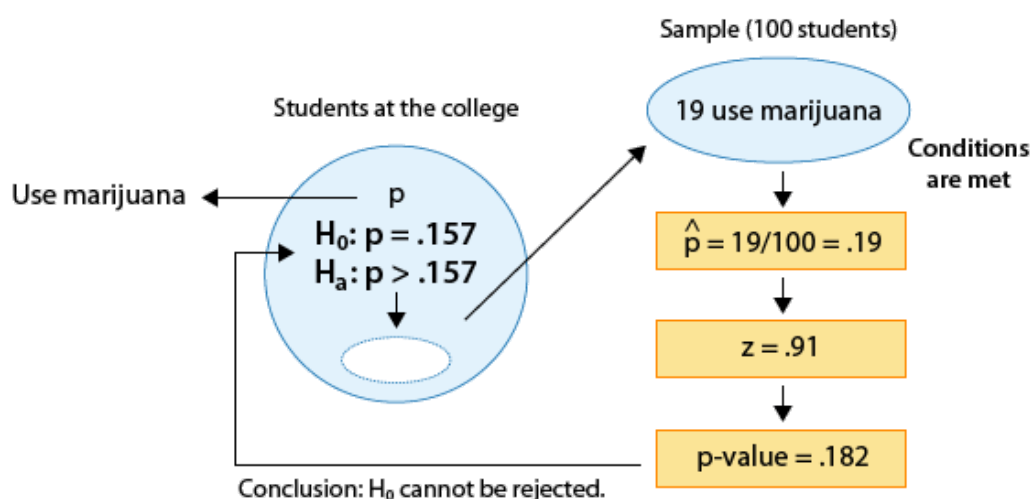
Learn By Doing Activity

Scenario: Marijuana Users in College

The purpose of this activity is to give you a better sense of the p-value, and in particular, help strengthen your intuition about how it measures the evidence against the null hypothesis.

Background:

In this activity we will use example 2. Recall that we've just completed this example, and summarized it using the following figure:



We've seen that the evidence the data provided—19 marijuana users out of a sample of 100—was not enough for us to conclude that the proportion of marijuana users in the college is higher than the national figure (0.157). An interesting question, therefore is: how many marijuana users out of 100 should we have found for it to be enough evidence to reject H_0 ? 19 was not enough, but what would have been enough? 21? 25?

Learn By Doing (1/1 point)

What do you think is the minimum number of marijuana users (out of 100 students) that would constitute enough evidence to reject H_0 and conclude that p is greater than 0.157? Use just your intuition. If you needed to decide whether to reject H_0 or not based on a sample of size 100 students, how many marijuana users would you need to find to convince you that indeed, p is greater than 0.157?(There is no right or wrong answer here.)

Your Answer:

30jQuery22403109194163358613_1584190920276?

Our Answer:

As the question states, there is no right or wrong answer at this point. Personally, not being a big "risk-taker," if I find that 25 out of the 100 are marijuana users, that will convince me to reject H_0 . Anything below 25 would not be enough for me. To help us answer this question more accurately, lets look at a table that lists various sample counts/proportions of users, the corresponding z statistic, and the associated p -value. Note that we highlighted in red the result we got in our sample—19 users. This is a great opportunity to see how the p -value "works" as a measure of evidence against H_0 ; the smaller it is the more evidence is "stored" in the data against H_0 . Obviously, if finding 19 marijuana users was not enough evidence to reject H_0 and conclude that p , the proportion of marijuana users in the college is higher than 0.157 (the national figure), then anything below 19 would not be enough either, since it provides even less evidence against H_0 . See in the green section of the table how this is depicted by the values of the p -value, which get larger as the number of marijuana users gets smaller. On the other hand, it is pretty clear that the more marijuana users we see in our sample, the more evidence we have to reject H_0 and conclude that $p > 0.157$. Indeed, note that the p -values get smaller as the number of marijuana users increases.

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The table below will help you check your intuition. In the boldfaced row, we see our finding that when 19 out of 100 students are found to be users of marijuana, the test statistic is $z = 0.91$ (the table provides the non-rounded value), and the p -value is roughly 0.182 (indicating that 19 out of 100 users of marijuana does not provide enough evidence to conclude that $p > 0.157$).

Data: x Use Marijuana	Test Statistic	p-Value Associated with x
15	-0.19241	0.576291
16	0.08246	0.467139
17	0.35734	0.360419

18	0.63221	0.263623
19	0.90709	0.182180
20	1.18197	0.118610
21	1.45684	0.072580
22	1.73172	0.041662
23	2.00659	0.022397
24	2.28147	0.011260
25	2.55634	0.005289

The row below the boldfaced row shows the test statistic and p-value results had we found that 20 out of 100 students were marijuana users: the test statistic increases to roughly 1.18 (since $20/100 = 0.2$ is further away from 0.157 than $19/100 = 0.19$) and the p-value decreases to roughly 0.12 (since 20 out of 100 marijuana users provides stronger evidence than 19 out of 100).

The table shows the individual results for 15 through 25 out of 100 users of marijuana. Use the information provided in the table to answer the questions below.

Learn By Doing (1/1 point)

At the 0.05 significance level, how high does the number of marijuana users in the sample need to be for there to be enough evidence to reject H_0 and conclude that indeed $p > 0.157$? Answer the same question for a significance level of 0.01. How do your answers to this question compare with your intuitive answer to question 1?

Your Answer:

22 for 0.05, 25 for 0.01. My answer was kinda random, so it's quite far off.

Our Answer:

This table provides the answer. A random sample of size 100 with 22 marijuana users would be enough evidence to reject H_0 at the 0.05 significance level. In order to be able to reject H_0 at the more conservative 0.01 significance level, a random sample of size 100 with 25 (or more) marijuana users is needed.

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Learn By Doing (1/1 point)

Note that the p-value corresponding to 25 marijuana users is 0.005. Interpret this value in context.

Your Answer:

This means there's a probability of 0.005289 to observe a z-value of 2.56 -- to find 25 users or more in a random sample size of 100 students. H_0 will be rejected, H_a will be accepted at any significance level greater than 0.005.

Our Answer:

Recall that in general the p-value tells us how likely it is to get data as extreme as those observed (or even more extreme) if the null hypothesis is true. In this case, if p , the proportion of marijuana users in the college, were really 0.157, it would pretty unlikely/surprising (probability of only 0.005) to find 25 marijuana users or more in a random sample of size 100.

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