Learn By Doing Activity

Now, we will address the issue of statistical significance versus practical importance (which also involves issues of sample size).

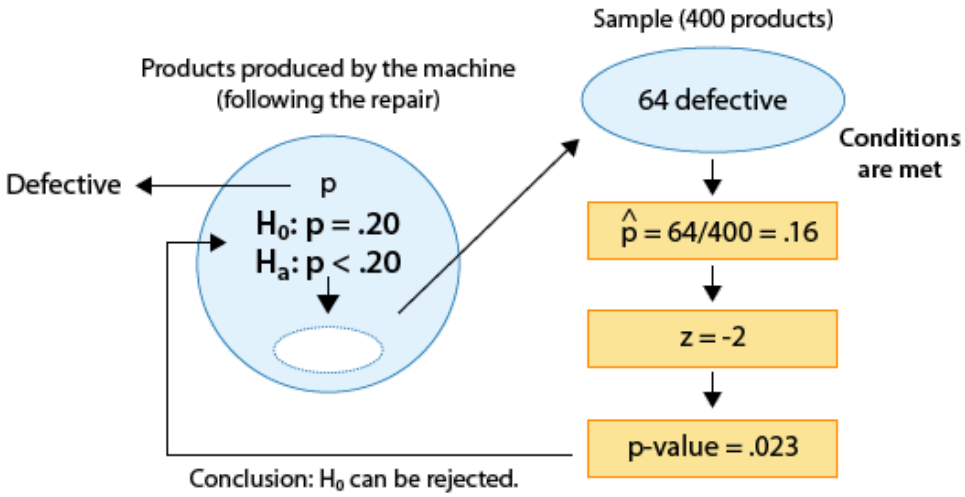
The following activity will let you explore the effect of the sample size on the significance of the results yourself, and more importantly will discuss issue 2: Statistical significance vs. practical importance.

Scenario: Repairs to Eliminate Defective Products

The purpose of this activity is to give you guided practice exploring the effect of sample size on the significance of sample results, and help you get a better sense of this effect. Another important goal of this activity is to help you understand the distinction between statistical significance and practical importance.

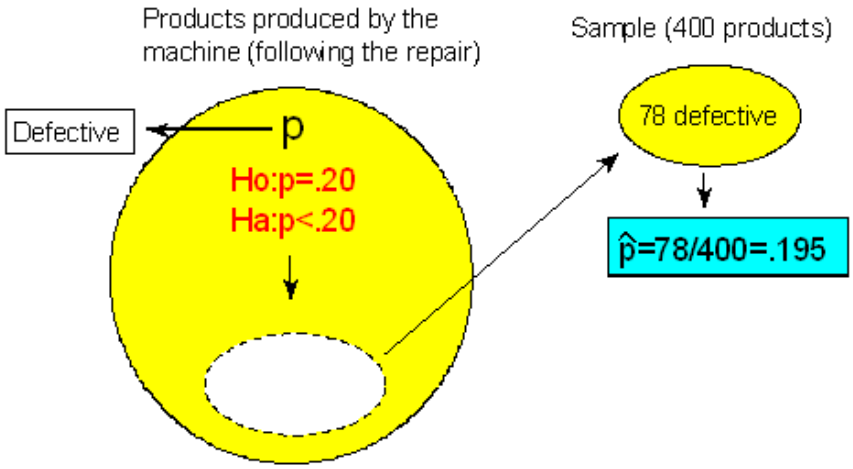
Background:

For this activity, we will use example 1. Here is a summary of what we have found:



The results of this study—64 defective products out of 400—were statistically significant in the sense that they provided enough evidence to conclude that the repair indeed reduced the proportion of defective products from 0.20 (the proportion prior to the repair). Even though the results—a sample proportion of defective products of 0.16—are statistically significant, it is not clear whether the results indicate that the repair was effective enough to meet the company's needs, or, in other words, whether these results have a practical importance. If the company expected the repair to eliminate defective products almost entirely, then even though statistically, the results indicate a significant reduction in the proportion of defective products, this reduction has very little practical importance, because the repair was not effective in achieving what it was supposed to. To make sure you understand this important distinction between statistical significance and practical importance, we will push this a bit further.

Consider the same example, but suppose that when the company examined the 400 randomly selected products, they found that 78 of them were defective (instead of 64 in the original problem):



Learn By Doing (1/1 point)

Note that the sample proportion of defective products is 0.195. Regardless of whether the results are statistically significant or not, comment on the practical implication of the results.

Your Answer:

20% defect rate is pretty bad for business

Our Answer:
A sample proportion of 0.195 (19.5% defective products) tells us that practically, the repair was ineffective in reducing the proportion of defective products. It is hard to imagine a situation where a company would consider a reduction of 0.5% a practically important reduction in the proportion of defective products.

Resubmit Reset

Learn By Doing (1/1 point)

We conduct a z-test and get the following output: H0: p = 0.2 HA: p < 0.2 z = -0.25, p-value = 0.4013 Based on the output, comment on the (statistical) significance of the results, and state your conclusions in context.

Your Answer:

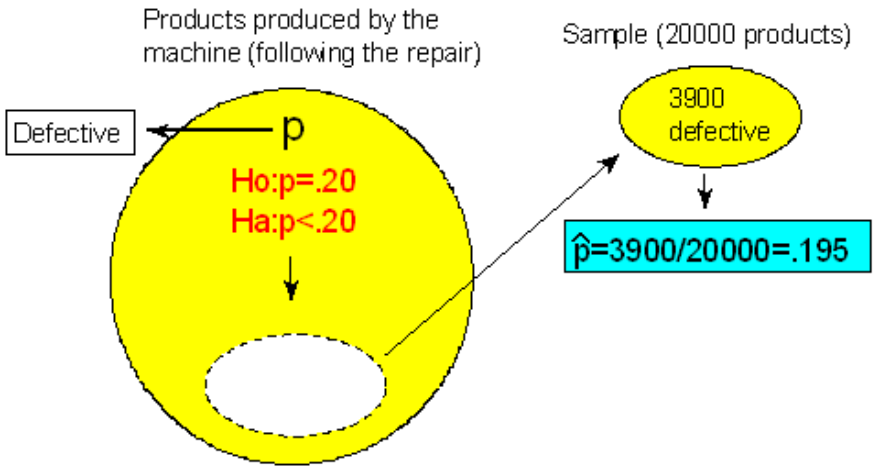
it's greater than 0.05 so there's not enough evidence to reject Ho. There's 40% chance to observe 0.25 standard deviations below 20%.

Our Answer:
Based on the large p-value (0.401) we conclude that the results are not statistically significant. In other words, the data do not provide evidence to conclude that the proportion of defective products has been reduced.

Resubmit Reset

Scenario: Repairs to Eliminate Defective Products Extended

Consider now another variation on the same problem. Assume now that over a period of a month following the repair, the company randomly selected 20,000 products, and found that 3,900 of them were defective.



Note that the sample proportion of defective products is the same as before, 0.195, which as we established before, does not indicate any practically important reduction in the proportion of defective products.

Learn By Doing (1/1 point)

We conduct a z-test on the additional data and get the following output: H0: p = 0.2 HA: p < 0.2 z = -1.76, p-value = 0.0385 Based on the output, comment on the (statistical) significance of the results and state your conclusions in context.

Your Answer:

Now significant because 0.04 is less than 0.05.

Our Answer:

Even though the sample results are similar to what we got before (sample proportion of 0.195), since they are based on a much larger sample (20,000 compared to 400) now they are statistically significant (at the 0.05 level, since 0.039 is less than 0.05). In this case, we can therefore reject H0 and conclude that the repair reduced the proportion of defective products below 0.20. Summary: This is perhaps an “extreme” example, yet it is effective in illustrating the important distinction between practical importance and statistical significance. A reduction of 0.005 (or 0.5%) in the proportion of defective products probably does not carry any practical importance, however, because of the large sample size, this reduction is statistically significant. In general, with a sufficiently large sample size you can make any result that has very little practical importance statistically significant. This suggests that when interpreting the results of a test, you should always think not only about the statistical significance of the results but also about their practical importance.

Resubmit Reset