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Statistical Power

Power represents the ability of a hypothesis test to detect true differences between the null and alternative hypothesized values. Power is analogous to the resolution of a microscope. The higher the power, the smaller the features that can be distinguished.

There are several factors that influence the power of a test: the significance level, α the sample size, *n*, the variability of the population; and the size of the difference that you want to detect.

Let's look at these one at a time.

The first factor is the significance level, α. The higher the significance level, the higher the power of the test for a given sample size and specified difference. Consider the inspection of parts. The more parts that are rejected, the more bad parts that are caught. Likewise, the lower the number of parts rejected, the more bad parts that make it to the customer.

The second factor is the sample size, *n*. By increasing the sample size, you can increase the power of your test. Tests involving small sample sizes will have little power to detect real differences. The more data you have, the more the power you have.

The third factor is the variability of the population. The more variable, or noisy, the population, the lower the power of the test. Noise clouds your ability to see what's really going on. The less variable the population, the greater the ability to detect critical differences.

Consider this analogy. You are standing on a dock on a calm lake. If the water is clear (there is no noise), you can see the fish, rocks, and other items beneath the surface. However, if the water is cloudy and full of debris (or noise), then you might not be able to see these objects, even though they are there just beneath the surface.

The fourth factor influencing power is the size of the difference, or effect. The smaller the difference that you are trying to detect, the less power you have to detect this difference. Using the dock analogy, even if the water is very clear, you might not be able to see small fish or rocks. You might be able to see them only if they are very large.

From an engineering or scientific perspective, the size of the difference that you need to detect is a practical question. For example, suppose that you will be conducting a one-sample t test, where your alternative hypothesis is that the process is off target. The size of the difference that you need to detect is based on the maximum deviation from target that you are willing to accept. We revisit this scenario in the next video.

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