Hypothesis Testing

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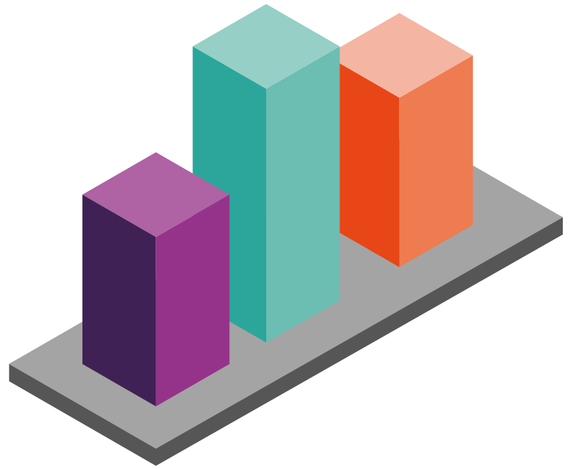
Descriptive vs. Inferential Statistics



Previously, we already talked about descriptive statistics. Descriptive statistics describe a sample and that's pretty straightforward. You simply take a group that you're interested in, record data about the group members, and then use summary statistics and graphs to present the group properties. There is no uncertainty because you are describing only items that you actually measure.

Inferential statistics takes data from a sample and makes inferences about the larger population from which the sample was drawn. Drawing inferences about a population is particularly important in science where we want to apply the results to a larger population, not just the specific sample in the study

Hypothesis

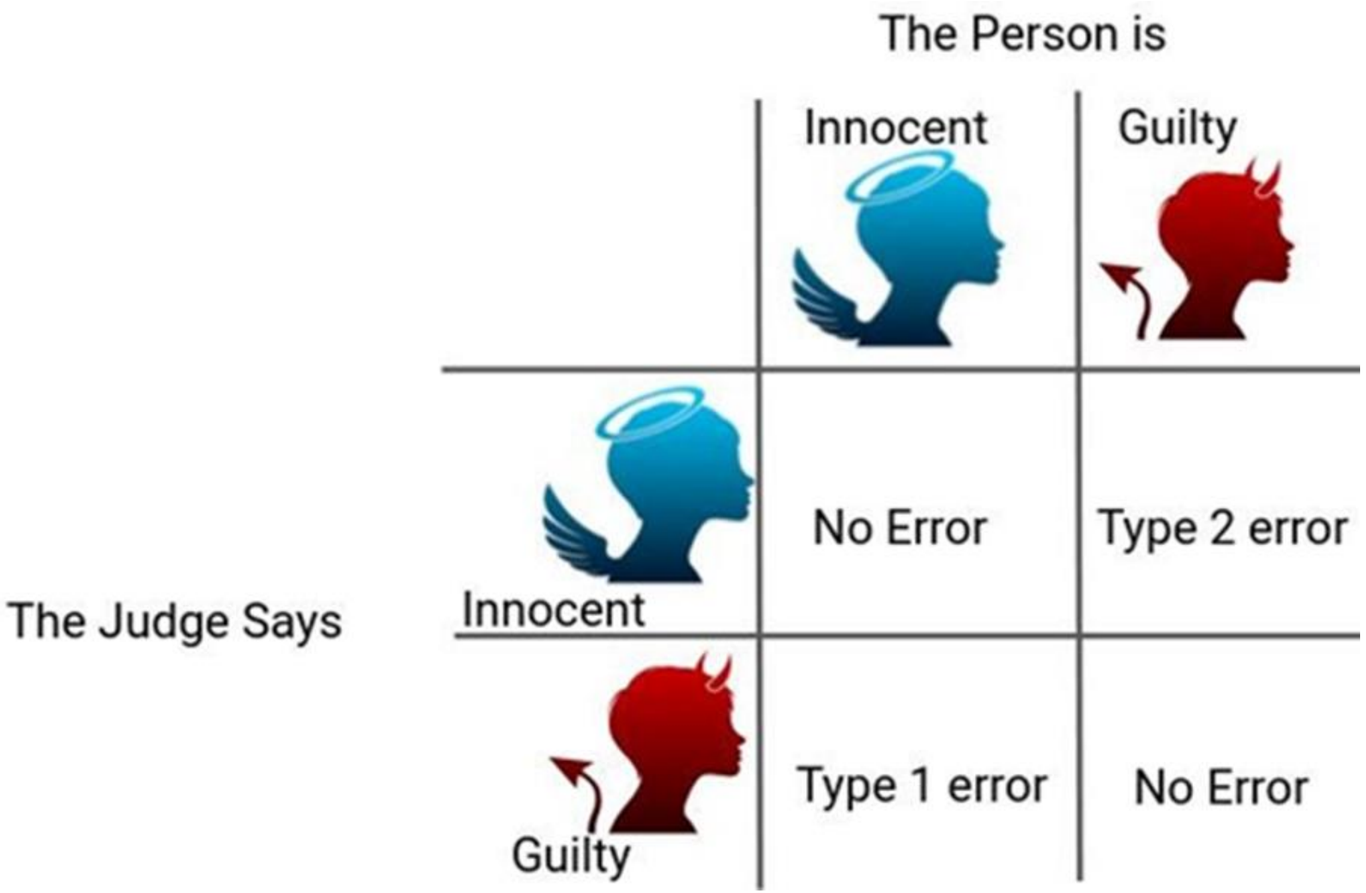
A hypothesis is an educated guess about something in the world around you. It should be testable, either by experiment or observation. For example:

- A new medicine you think might work.
- A way of teaching you think might be better.
- A possible location of new species.
- A fairer way to administer standardized tests.

It can really be anything at all as long as you can put it to the test.

Fundamental of Hypothesis Testing

Source :
https://www.analyticsvidhya.com



Simple Hypothesis Test Statistic

There are four steps to perform Hypothesis Testing:

STEP 1: State the hypotheses. (Population)

α

STEP 2: Set the level of Significance (Criterion)

STEP 3: Compute test Statistics (Sample)

p

STEP 4: Make a decision based on p value

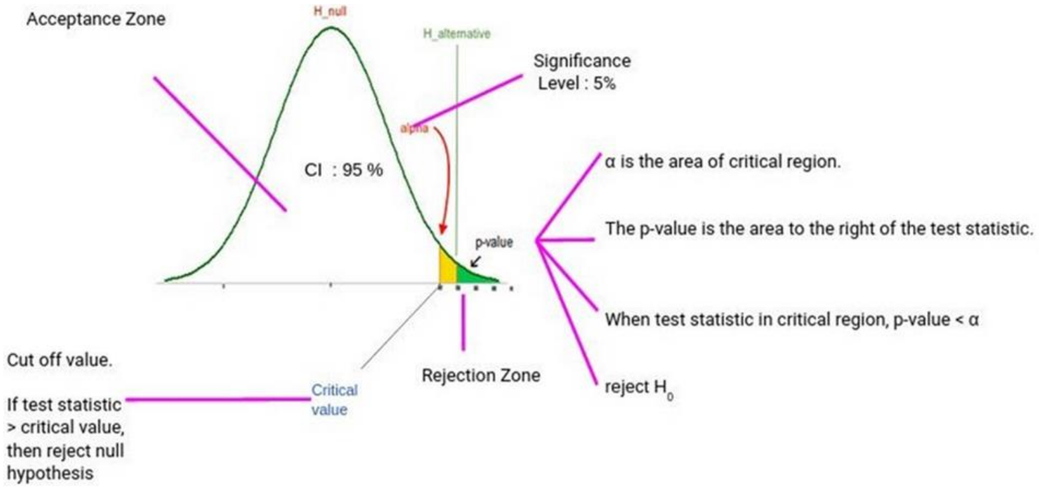
Simple Hypothesis Test Statistic

1.Set the Hypothesis

The null hypothesis (H0). The null hypothesis is a statement that will be tested for truth. Alternative hypothesis (H1). An alternative hypothesis is a statement when the statement (H0) is rejected.

2.Set the Significance Level, Criteria for a decision

Critical Value is the cut off value between Acceptance Zone and Rejection Zone.



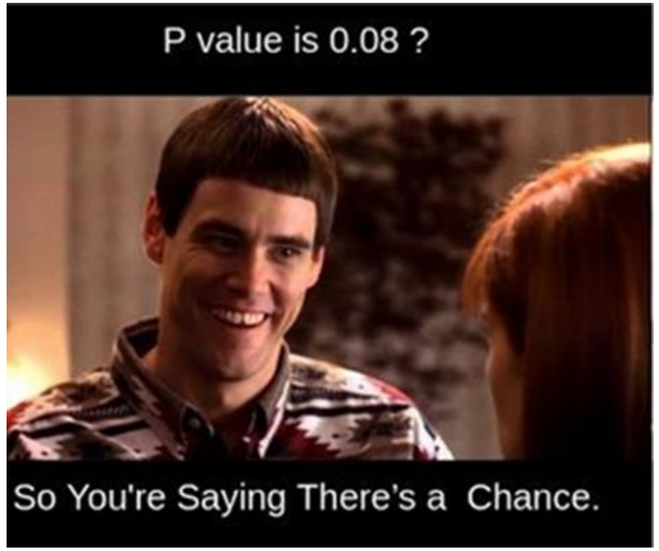
Simple Hypothesis Test Statistic

3. Compute the test statistics

4. Make a decision

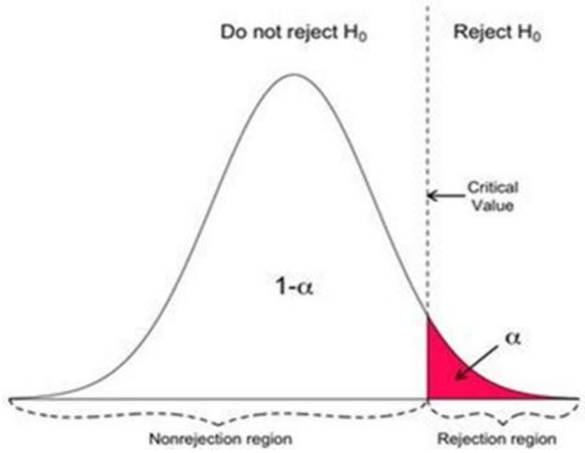
Test score > critical value, then reject the null Hypothesis
Test score < critical value, then fail to reject the null Hypothesis

p-value < α , then reject H0 or the result is statistically significant.
p-value ≥ α, then accepted H0 or the result is statistically insignificant



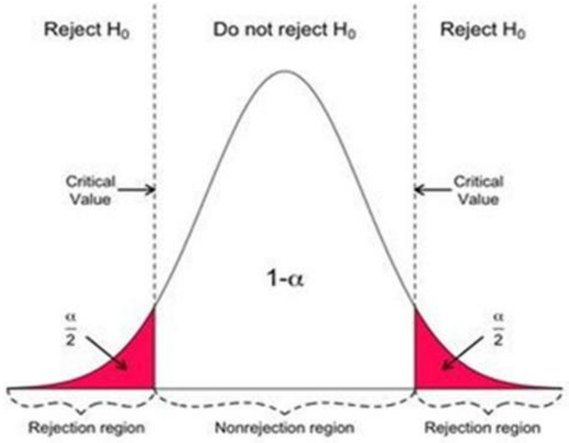
Directional Hypothesis

The null hypothesis is rejected if the test score is too large (for right-tailed and too small for left tailed). Thus, the rejection region for such a test consists of one part, which is right from the center.

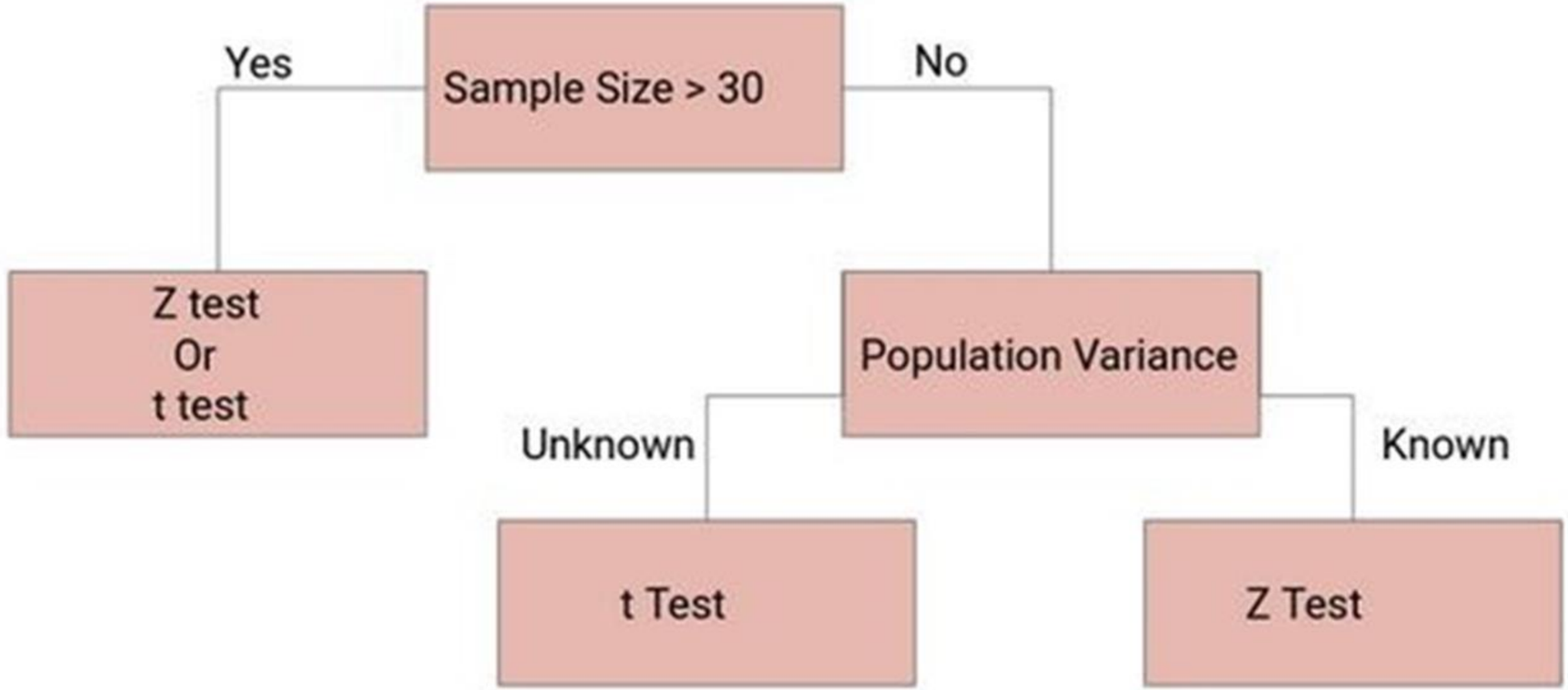


Non-Directional Hypothesis

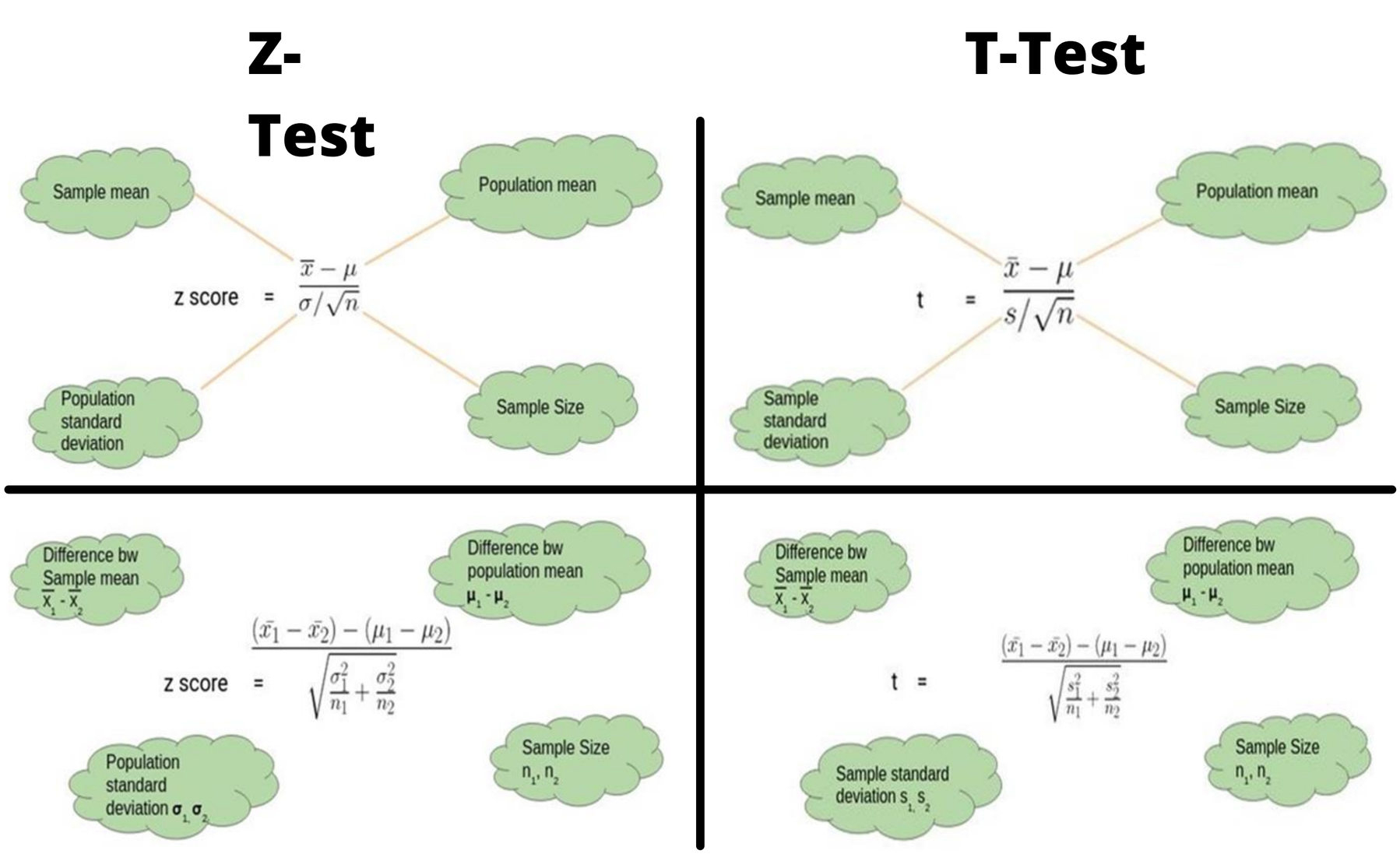
The Null Hypothesis is rejected if the test score is either too small or too large. Thus, the rejection region for such a test consists of two parts: one on the left and one on the right.



When we should perform the Z test and when we should perform t-Test?



Source : https://www.analyticsvidhya.com



Source : https://www.analyticsvidhya.com

Fundamental of Statistical Power

Types of Error:

Type I Error

It rejects the null hypothesis when there is no significant effect (which we call false positive). Here the p-value is small.

Type II Error

It doesn't reject the null hypothesis when there is a significant effect (called as false negative). Here the p-value is large.

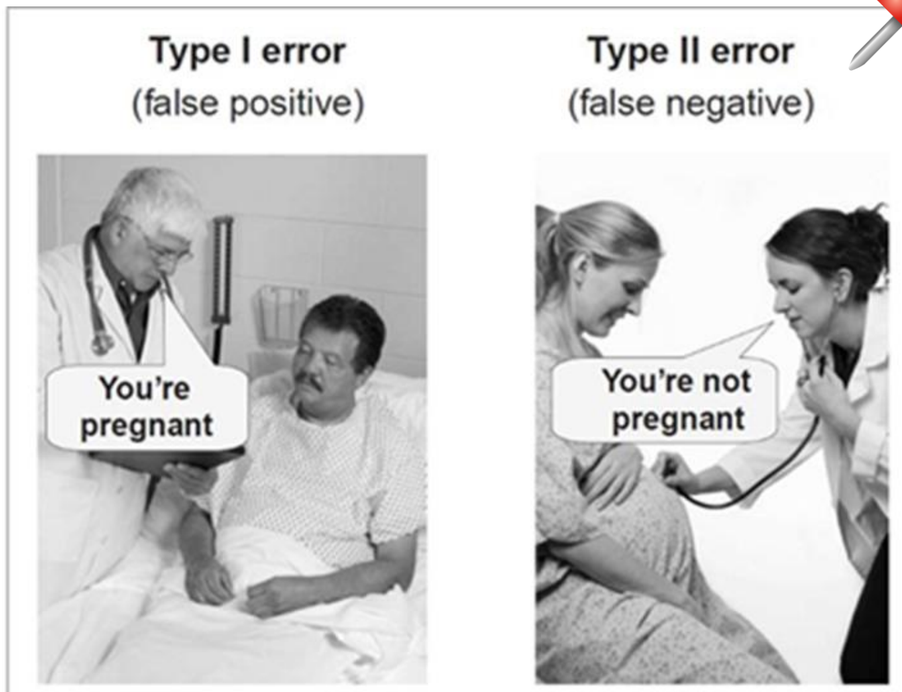


Figure 3.1 Type I and Type II errors

Source : https://medium.com/

Statistical Power

Statistical power or the power of a hypothesis test is a probability of receiving a null hypothesis when the hypothesis is true.

		Kondisi **populasi** sebenarnya	
Keputusan berdasarkan **sampel**		H_0 benar	H_0 salah
	Tolak H_0	Error tipe 1 = α	Keputusan tepat = $1 - \alpha$
	Terima H_0	Keputusan tepat = $1 - \beta$ = **POWER**	Error tipe II = β

Source : https://tau-data.id/

The higher the statistical power for an experiment, the lower the probability of making a Type II (false negative) error. That is the higher the probability of detecting an effect when there is an effect.

Power = 1 — Type II Error

Pr(True Positive) = 1 — Pr(False Negative)

Statistical Power

Generally, statistical power is related to four parts

Effect size

The quantified magnitude of a result present in the population. Effect size is calculated using a specific statistical measure.

Significance

The significance level used in the statistical test, e.g. alpha. Often set to 5% or 0.05.

Sample size

The number of observations in the sample

Statistical Power

The probability of accepting the alternative hypothesis if it is true.

As a beginner, we can start with sensible defaults for some parameters, such as a significance level of 0.05 and a power level of 0.80.

As usual, let's try it out!

Let’s try to do a simple Z and T Test

Open the Z_Test and T_Test notebook files on JupyterLab