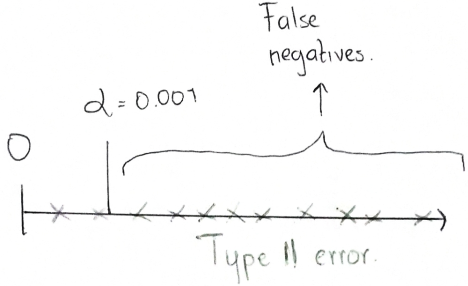
(A)

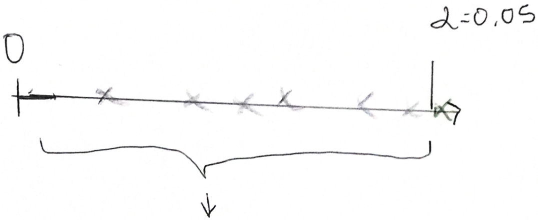
We set a small cutoff.



Result: we fail rejecting the null in cases that we should.

(B)

We set a relatively big cut-off.



Result: we reject the null in cases that we should not..

false positives

Type I error

Power

Positive or negative: The act of rejecting the null hypothesis

$$\frac{\bar{X} - \bar{Y}}{\sqrt{\frac{\sigma_x^2}{M} + \frac{\sigma_y^2}{N}}} \sim N(0,1)$$

$$\text{Power} = f\left(\text{Size effect: } \mu_x - \mu_y \,,\; \text{Estimates standard error} = f\left(\text{Sample size}\right) \,\&\, f\left(\text{Pop. sd}\right) \right)$$

Type I error: the event of rejecting the null hypothesis when it is in fact true.

Type II error rate + Power = 1

Type I error rate. Probability of making a Type 1 error.

Power = 1 - Type II error rate.

Type II error rate. Probability that we fail rejecting the null hypothesis when the alternative is true

Power = probability of rejecting the null hypothesis when the alternative hypothesis is true.

Significance level (α): treshold we set to know when we will reject the null hypothesis using the p-value.

The 0.05 and 0,01 cutoffs are Arbitrary.

The p-values get smaller and smaller with increasing the sample size because the numerator of the t-statistic has $\sqrt{N}$. Therefore, if $\Delta = \mu_x - \mu_y \neq 0$, the t-statistic will increase with N.

$$\bar{X} = \frac{1}{\boxed{N}} \sum_{i=1}^{\boxed{N}} x_i \quad ; \quad \sigma_x^2 = \frac{1}{\boxed{N}} \sum_{i=1}^{\boxed{N}} (x_i - \bar{X})^2.$$

$$\bar{Y} = \frac{1}{\boxed{M}} \sum_{i=1}^{\boxed{M}} y_i \quad ; \quad \sigma_y^2 = \frac{1}{\boxed{M}} \sum_{i=1}^{\boxed{M}} (y_i - \bar{Y})^2.$$

→ $\bar{X}$ & $\bar{Y}$ are random variables:

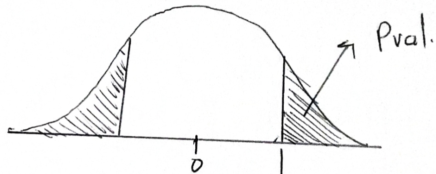
- $\bar{X} \sim N(\mu_x, \sigma_x)$
- $\bar{Y} \sim N(\mu_y, \sigma_y)$
- and, by CLT:

$$\frac{\bar{Y} - \bar{X}}{\sqrt{\frac{\sigma_x^2}{\boxed{N}} + \frac{\sigma_y^2}{\boxed{M}}}} \sim N(0,1) ; = t\text{-statistic.}$$

$$\Downarrow$$

$$t\text{-statistic} \propto \frac{1}{\frac{1}{\boxed{\sqrt{N}}}} = \boxed{\sqrt{N}}.$$

If $\sqrt{N}$ ↑↑↑ then t-statistic ↑↑↑.



abs(t) = quantile, defines 1-p and therefore p-val

if t-stat ↑↑↑, then p-val ↓↓↓