Hypothesis test

Questions

(example)

How can we answer?

Does the medicine effective?

?

literature

experiments

Hypothesis = assumption

Not a paradox?

evidence based medicine

assumption

?

Medical work

There is a big pain!

Hypothesis: **A** or **B** illnes?

more tests

Decision

You have **A** illnes.

Is it a right decision? How much is the chance of the mistake?

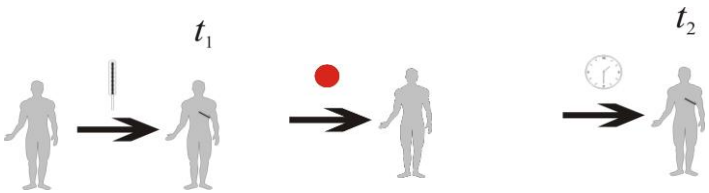
Sequence of the hypothesis test

Question → Answer: a hypothesis → aim of the examination: true or false?

An example

Qustion: Does the medicine decrease the fewer?

experiment



$$x = \Delta t = t_2 - t_1$$

How many trial is necessary?

Outcome: 1. $\Delta t > 0$; 2. $\Delta t = 0$; 3. $\Delta t < 0$.

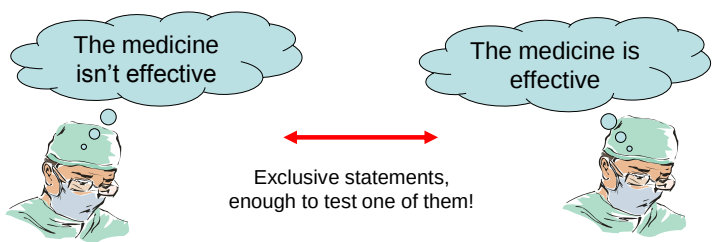
Is there a right decision?

Not only the medicine influences the body temperature! →

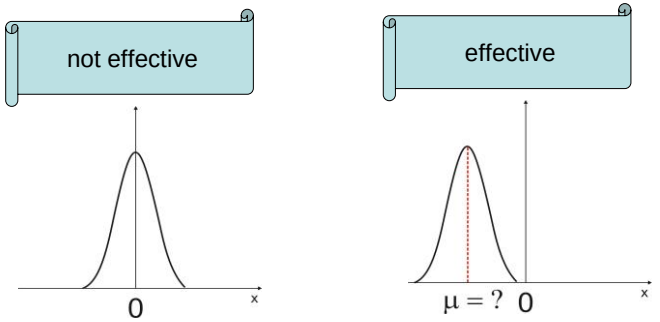
Assumption!

The other effects are random!

Hypothesises



The distribution of the observed quantity



The result of the random effects is that $\mu = 0$.

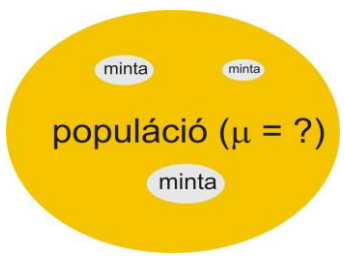
How much is the effect?

If we know the population!!! (we are able to calculate μ)

result:		conclusion:
$\mu = 0$	→	The medicine isn't effective.
$\mu < 0$	→	The medicine is effective and μ characterizes the effect.

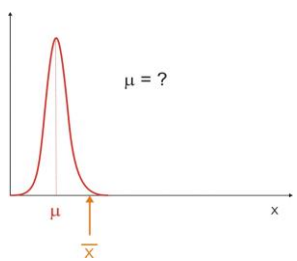
The situation is more difficult

Normally the population is unknown.



<u>The sample differs from the population!</u>

E.g. the averages fluctuate around the μ!



What is the reason of the deviation?

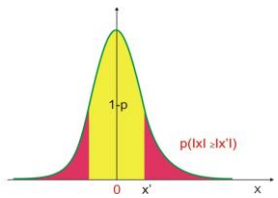
Sampling error, ***<u>random fluctuation</u>***.
(Our hypothesis is right!)

The hypothesis is false (<u>mistake</u>!).
The deviation is non-random.

What is the base of the decision?

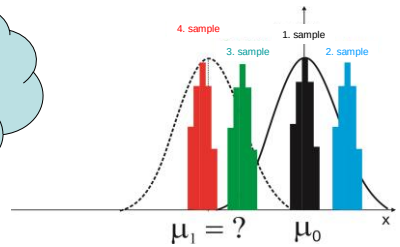
How much is the chance deriving from the given population?

We must know the parameters of the distibution!



Select hypothesis!

Which is the right population?



Known distribution!

Usual point of origin: **nullhypothesis**.

Nullhypothesis: (H_0)

The deviation of the sample or samples from the population or populations is a **random deviation** due to the sampling error. Frequently it is a negative answer. (e.g.: the medicine is not effective.)

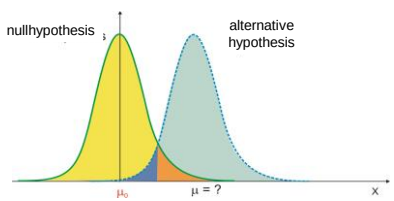
Alternative hypothesis: (H_1)

The deviation of the sample or samples from the population or populations is not a **random deviation**. (e.g.: the medicine is effective)

Decision

What is the base of decision?

We must have such kind of variables in which case we know the parameters!

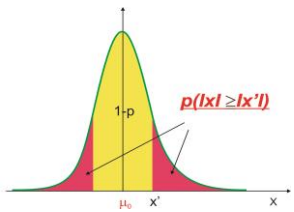


Nullhypothesis

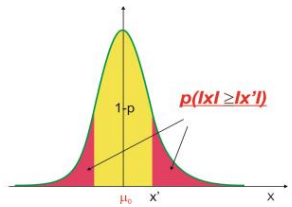
How much is the probability of the random deviation?

In the case of known distribution we are able to determine!

(The shape of the distribution not always gaussian, but known!)



Significant?



If the ***p*** is enough large, may be random, if the ***p*** is enough small we consider the difference being ***significant***!

p is the probability being **random**!

Significance level

Enough large, enough small?

Select a value as limit! This is the significance level.

Symbol: α.
In medical practice this value is frequently 5%.

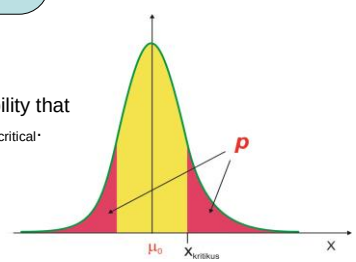
The base of the decision

If the ***p*** is enough small, there is a big chance, that the nullhypothesis is not true. So the alternative hypothesis is more probable.

$x_{critical}$: the value belonging to the significance level

$x_{calculated}$: the value calculated from the sample

p is the probability that $x_{calculated} \geq x_{critical}$.

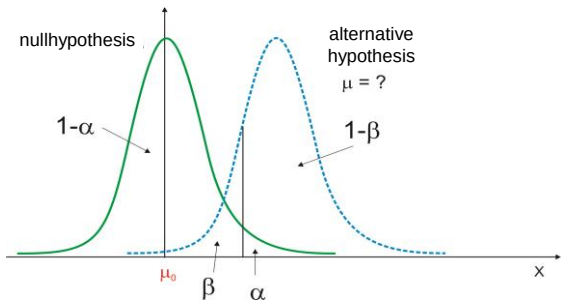


Decision

- 1. If the probability of the random deviation is small ($p(|x| \geq |x_{crit}|) \leq 5\%$) –we ***reject*** the nullhypothesis.
- 2. If the probability of the random deviation is large ($p(|x| \geq |x_{crit}|) > 5\%$) – we ***accept*** the nullhypothesis.

The answer is newer yes – no or true - false!!!

Quantities characterizing the decision



α: **significance level**. (The probability that we reject the nullhypothesis but, that is true.)

The possibility of the error

reality: the nullhypothesis	decision: the nullhypothesis is accepted	decision: the nullhypothesis is rejected
true	**Right decision**	**I. Type error (α)**
false	**II. Type error (β)**	**Right decision**