Hypothesis test

Questions

(example)

How can we answer?

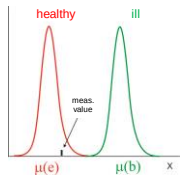
Does the medicine effective?

literature

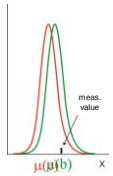
experiments

An example

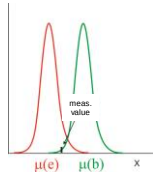
What does a measured value mean?



Practically separeted distributions .
Clear answer.
Very rare case.



Practically same distributions.
We cann't distinguish them.



Overlapping distributions.
There is no clear answer.
Most common case.

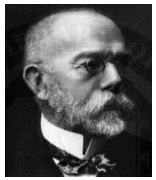
Hypothesis = assumption

Not a paradox?

evidence based medicine

assumption

?



Robert Koch's case with the anthrax

anthrax

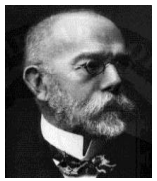
bacteria

Facts, data

Robert Koch

Question:

Bacteria is the agent or not?



Hypothesis

A. no relationship

B. bacteria is the agent

Exclusive statements, it is enough to test one of them.

experiments

Decision:

A. is true, so B is false

A. is false, so B is true

Medical work

There is a big pain!

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

more tests

Decision

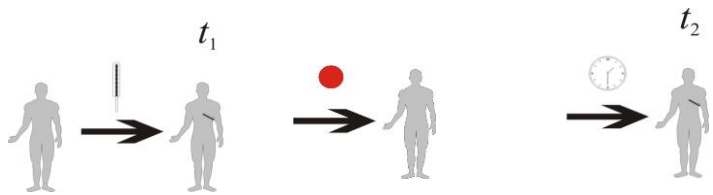
You have **A** illnes.

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

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. $\Delta t < 0$.

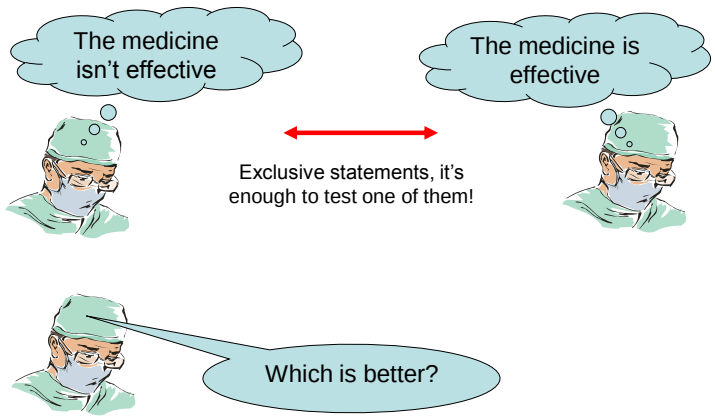
Is there a right decision?

Not only the medicine influences the body temperature!

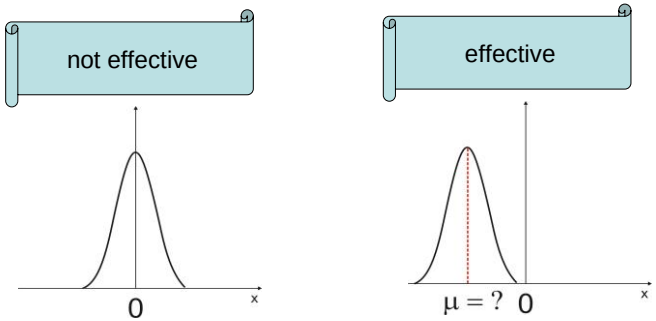
Assumption!

The other effects are random!

Hypothesises



The distribution of the observed quantity



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

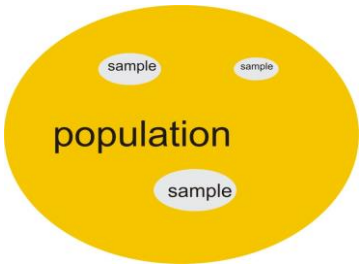
How much is the effectiveness?

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 effectiveness.

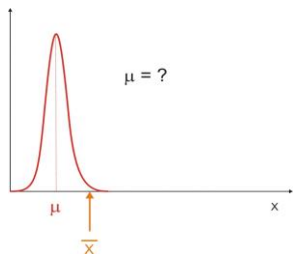
The situation is more difficult

Normally the population is unknown.



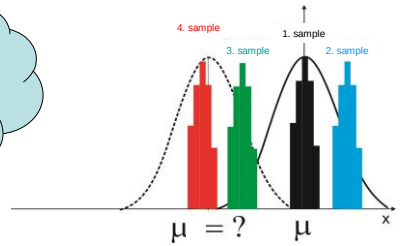
Samples are different from the population!

E.g. the averages fluctuate around the μ!



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)

The average is not the mean! What is the reason of the deviation?

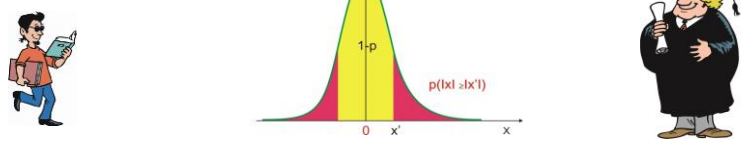
Sampling error, ***random fluctuation***. (Our hypothesis is right!)

The hypothesis is false (mistake!). The deviation is non-random.

What is the base of the decision?

How much is the chance of the given population?

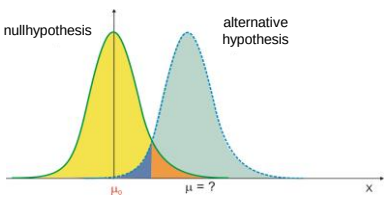
We must know the parameters of the distibution!



Decision

What is the base of decision?

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

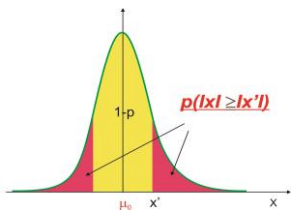


Nullhypothesis

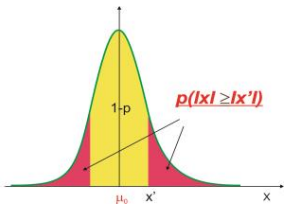
How probable is the random deviation?

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

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



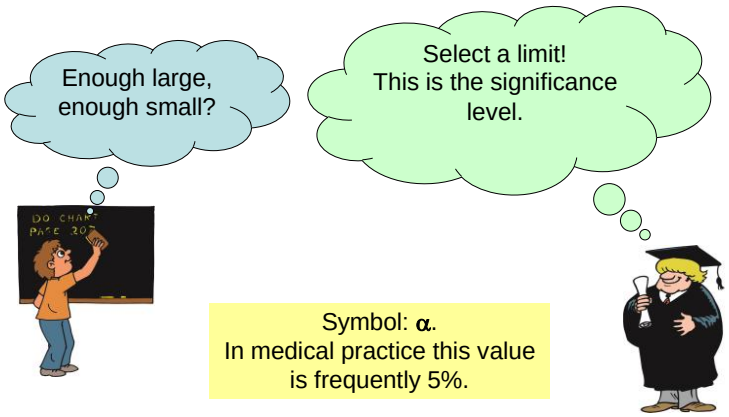
Significant?



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

p is the probability to be **random deviation**!

Significance level



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

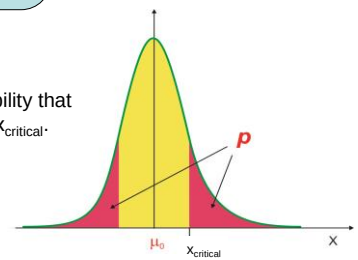
The base of the decision

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 $|x_{calculated}| \geq x_{critical}$.

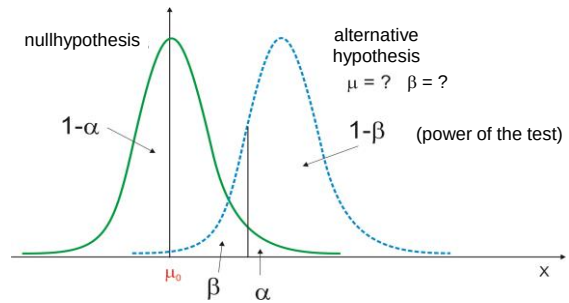


Decision

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

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

Quantities which characterise the decision



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

β: the probability that we accept the nullhypothesis when it is false.

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**

Hypothesis test