

Hypothesis test

Questions
(example)

Does the medicine effective?



How can we
answer?



literature



experiments

Hypothesis = assumption

evidence based
medicine



Not a paradox?

assumption

?



Robert Koch's case with the
anthrax

Facts, data

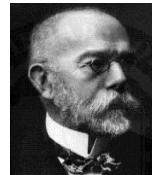
anthrax



bacteria



Robert Koch



Question:

Bacteria is the agent or
not?

Hypothesis

A. no relationship

B. bacteria is the agent



experiments

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

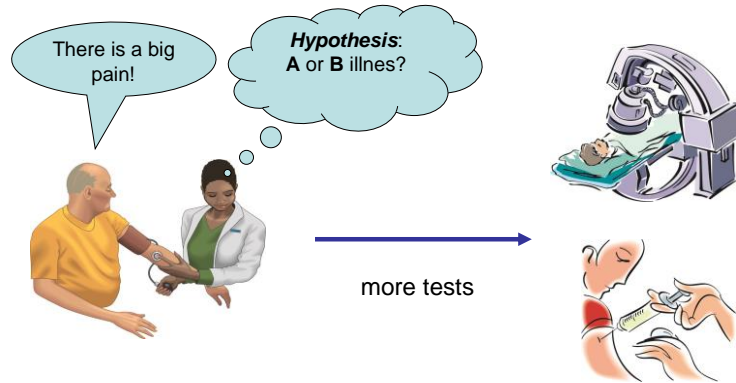


Decision:

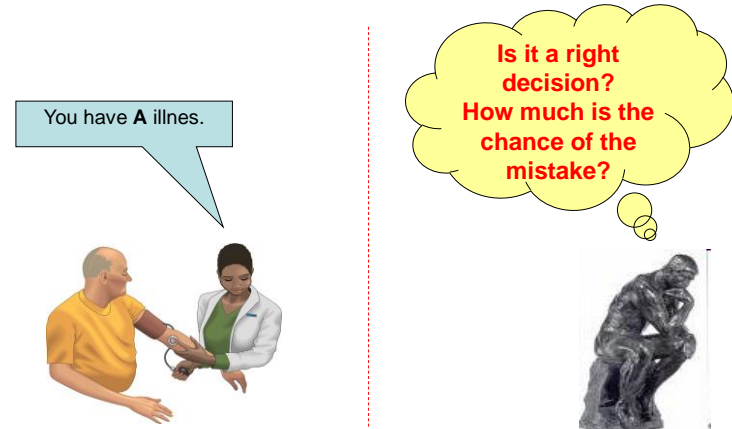
A. is true, so B is false

A. is false, so B is true

Medical work



Decision

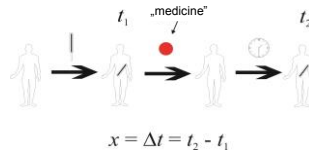


Decision. Why is it not so easy?

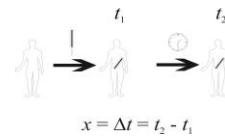
Question: The „medicine“ decreases the feaver or not?

Exprimtent:

„case“



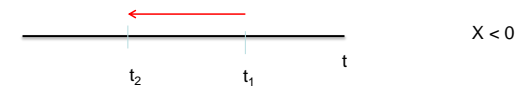
„control“



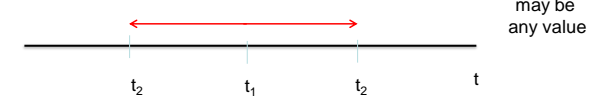
Effects

(that influence the body temperature)

1. „medicine“ : **effective medicine** decreases the body temperature!



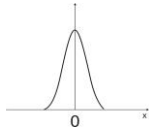
2. other, **random effects**: decrease, or increase the body temperature!



If the „medicine“ is not effective, the observation is same!

Population

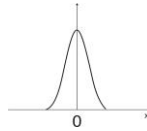
„control“:



The sum of the random effects 0!

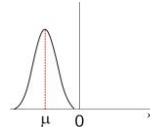
„case“:

the „medicine“ is not effective



The sum of the random effects 0!

the „medicine“ is effective



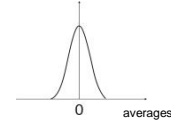
The difference characterizes the effectiveness of the medicine!

Sample

Problem: sampling error!
(The random difference of the average from the mean.)

„control“:

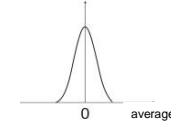
(deviations of the averages:)



averages

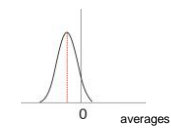
„case“:

„medicine“ is not effective



averages

„medicine“ is effective



averages

one sample: eg. average may be 0 in both situations!

two independent samples(case and control): the situation is same!

Hypotheses

The medicine isn't effective

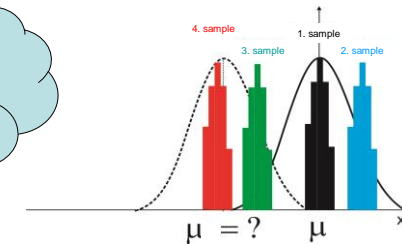
The medicine is effective

Exclusive statements, it's enough to test one of them!

Which is better?

Select hypothesis!

Which is the right population?



Known distribution!

Usual point of origin: **nullhypothesis**.

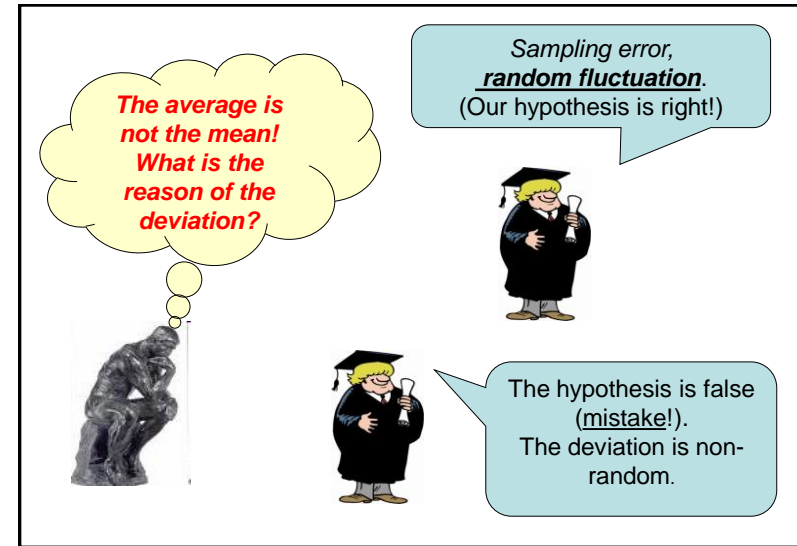
Nullhypothesis: (H_0)

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)

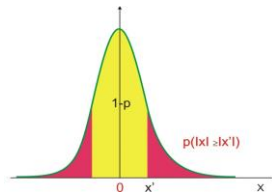


What is the base of the decision?

How much is the chance of the given population?

We must know the parameters of the distribution!

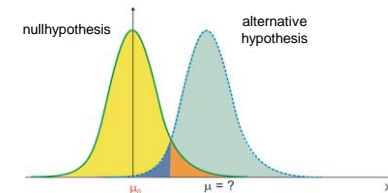
(We are able to calculate the probability!)



Decision

What is the base of decision?

As You see below, the nullhypothes is the right case only!



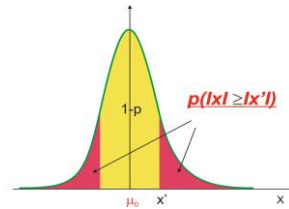
Nullhypothesis

How probable is the random deviation?

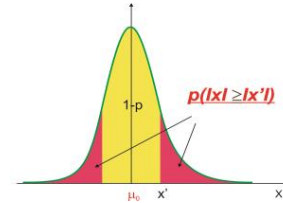


In the case of known distribution we are able to determine!

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



Significant?



p is the calculated probability of the random deviation!

If the p is enough large, the difference may be random, not significant, if the p is enough small we can say that the difference is significant!



Significance level

Enough large, enough small? What does it mean?

Select a limit between them! This is the significance level.



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



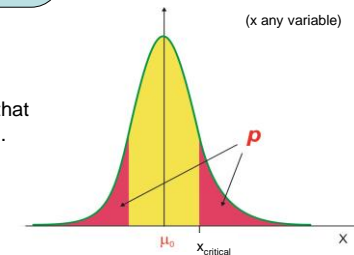
The base of the decision

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

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

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

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

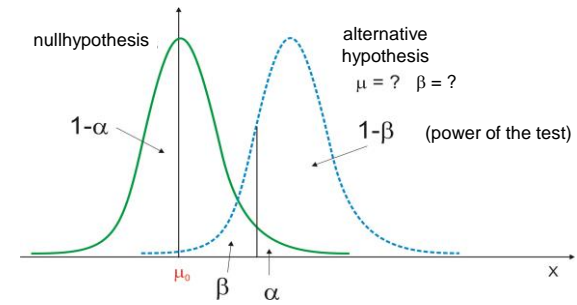


Decision

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

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

Hypothesis test

