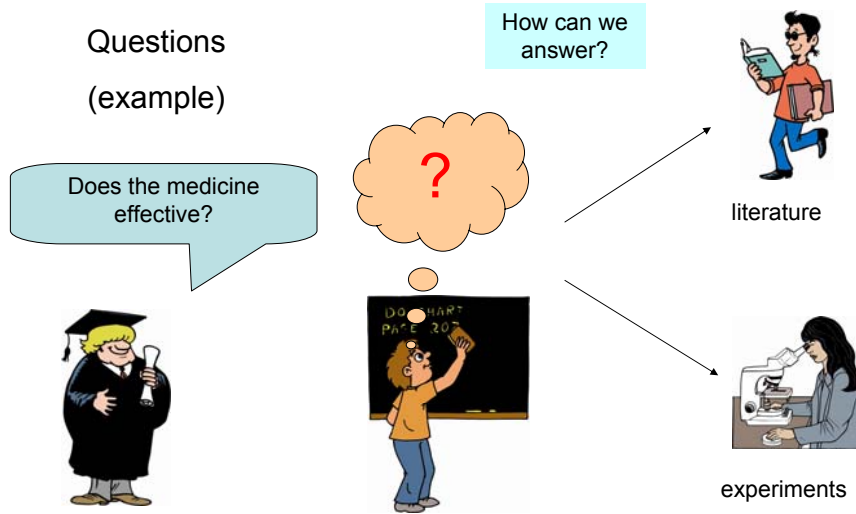
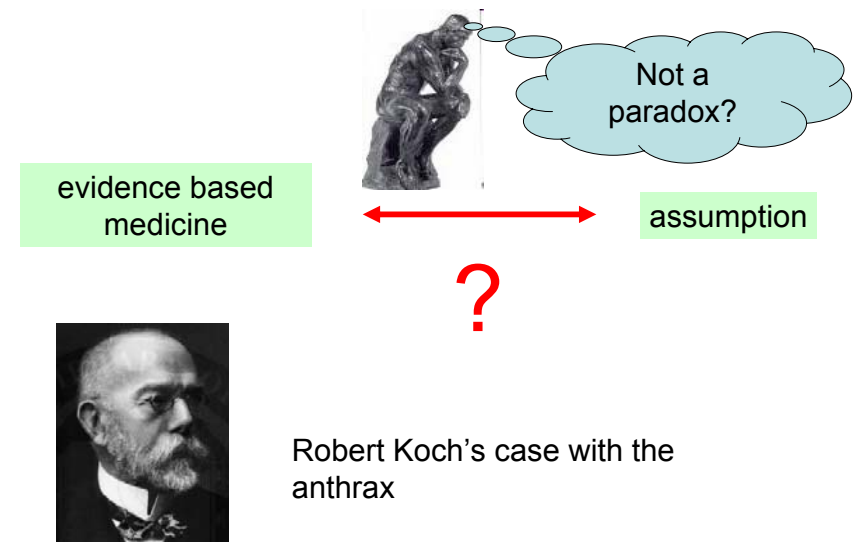


Hypothesis test



Hypothesis = assumption



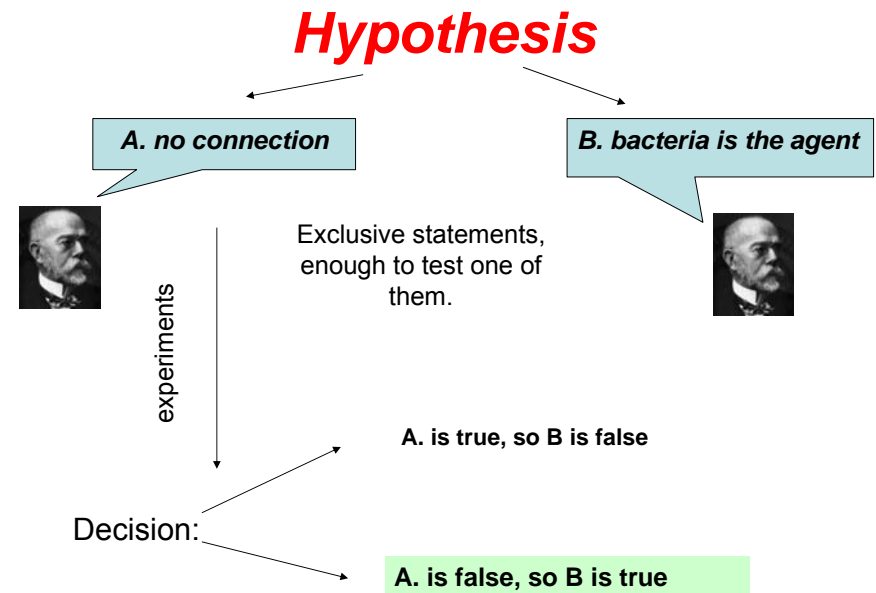
Facts,
data

anthrax

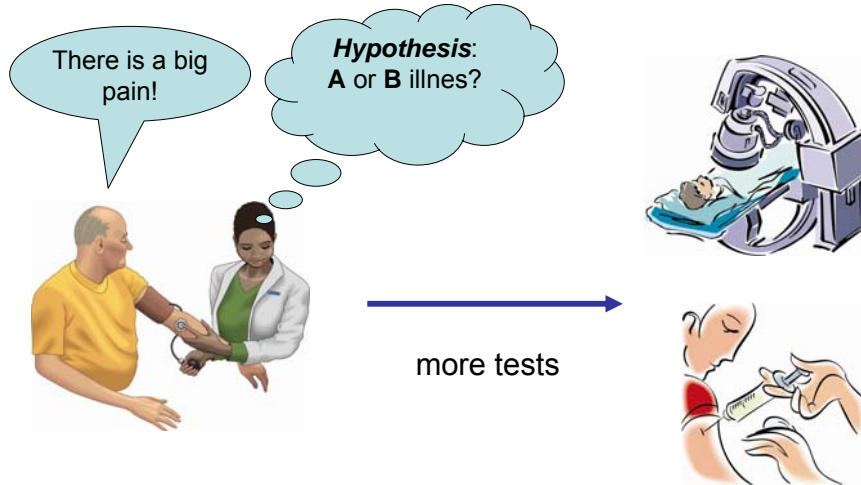
bacteria

Robert Koch

Question: Bacteria is the agent
or not?



Medical work



Decision

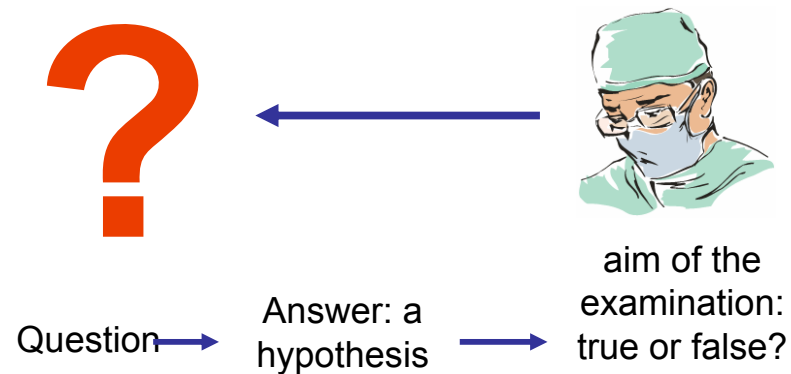
You have A illness.



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



Sequence of the hypothesis test



Question and hypothesis

Population



unknown parameters

supposed population



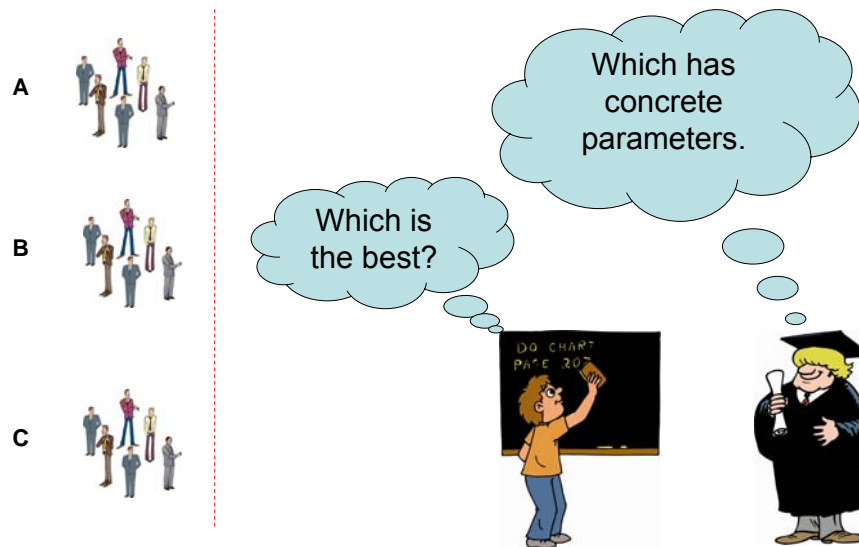
known, or hypothetical parameters

question ?



possible answer

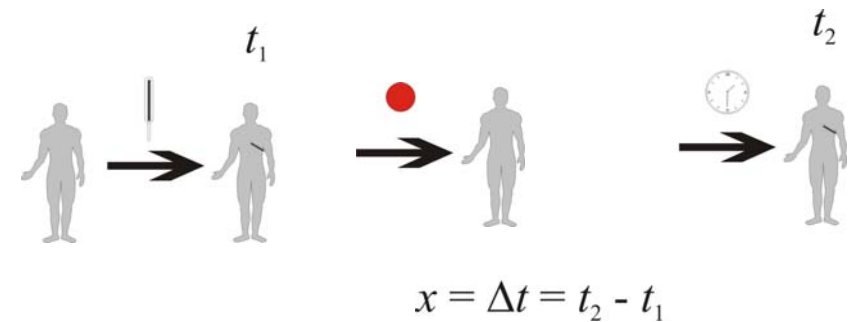
Many probable populations



An example

Question: Does the medicine decrease the fever?

experiment



How many trial is necessary?

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

Is there a right decision?

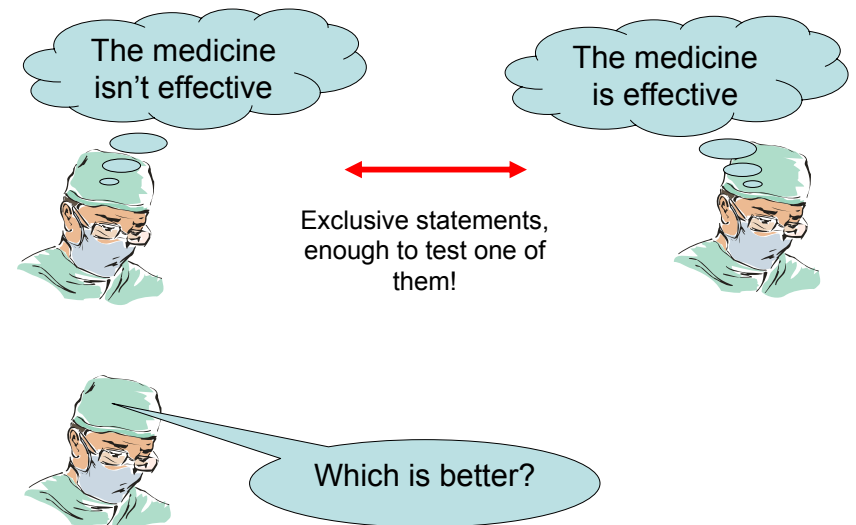
Not only the medicine influences the body temperature!



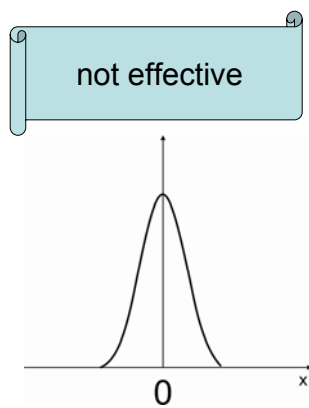
Assumption!

The other effects are random!

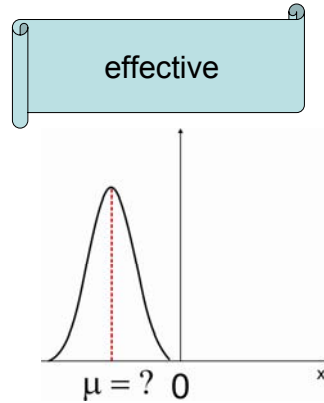
Hypotheses



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:

$$\mu = 0$$



conclusion:

The medicine isn't effective.

$$\mu < 0$$



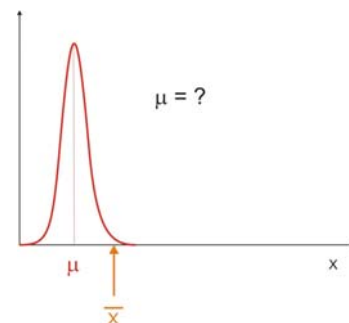
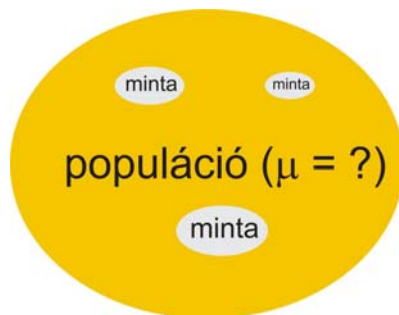
The medicine is effective and μ characterizes the effect.

The situation is more difficult

Normally the population is unknown.

The sample differs from the population!

E.g. the averages fluctuate around the μ !



What is the reason of the deviation?



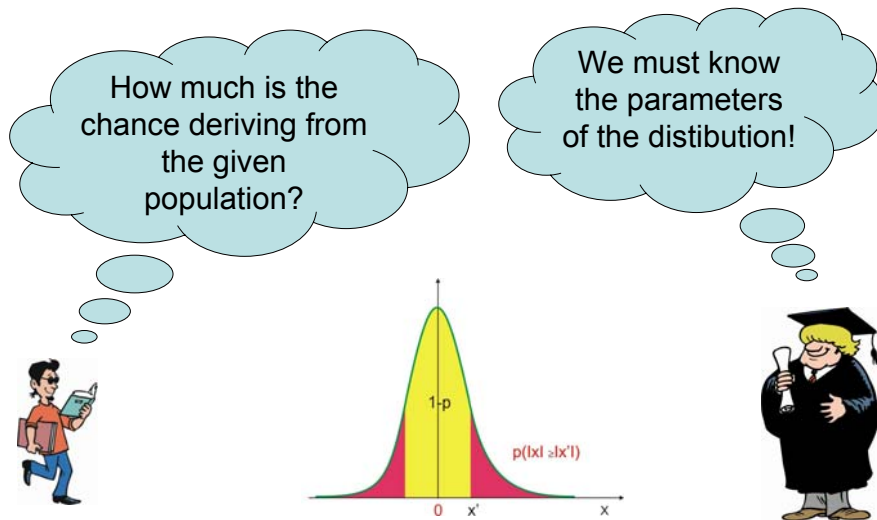
Sampling error, random fluctuation.
(Our hypothesis is right!)



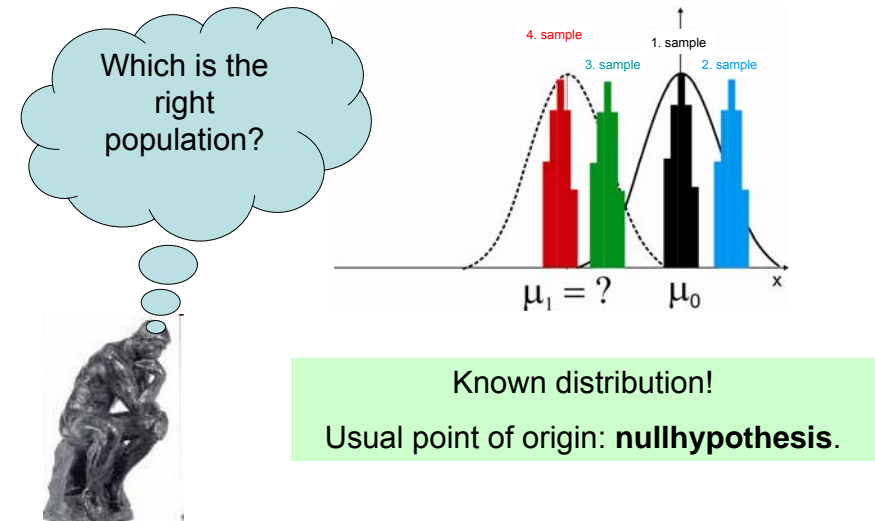
The hypothesis is false (mistake!).
The deviation is non-random.



What is the base of the decision?



Select hypothesis!



Nullhypothesis: (H_0)

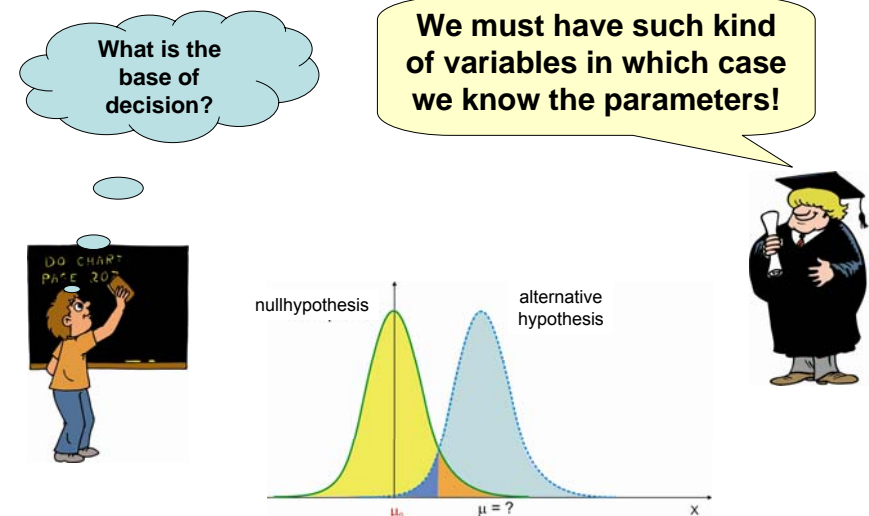
The deviation of the sample or samples from the population or populations is a random deviation due to the sampling error. Frequently it is a negative answer. (e.g.: the medicine is not effective.)



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



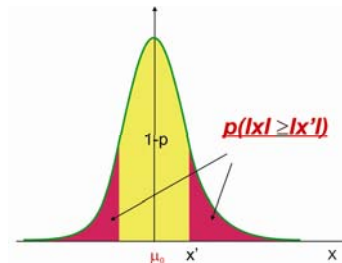
Nullhypothesis

How much is the probability of the random deviation?



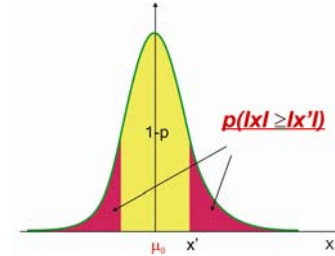
In the case of known distribution we are able to determine!

(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%.



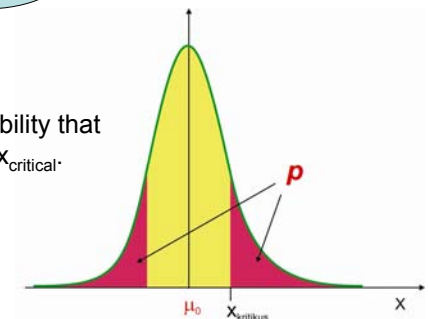
The base of the decision

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

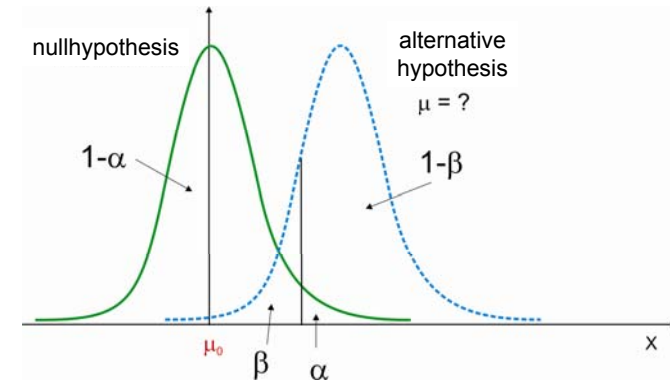


Decision

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

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