On statistical tests

1. Competing hypotheses H_0 and H_a, which are the logical complement of each other. We try to prove H_a by disproving H_0.

2. The errors. Since sample data is used to make a decision about the entire population, errors can not be avoided with 100% certainty.

   type I error – the error of rejecting H_0 even though H_0 is true

   type II error – the error of failing to reject H_0 even though H_0 is false

		Truth	
		H_0 is true	H_0 is false
Test	reject H_0	type I error	OK
	do not reject H_0	OK	type II error

   In a statistical test the probability for an error of type I is controlled ($\leq \alpha$), but the probability for an error of type II should be considered unknown. Therefore,

   - when H_0 is rejected, one could make an error of type I, the probability is small, we can be pretty certain the decision is correct (not 100% though).
   - when H_0 is not rejected, one could make an error of type II, the probability for this possible error is unknown, better do not commit to the decision (do not accept H_0).

3. The required components in a complete test

   (1) Hypotheses and significance level, α. Choose H_0 and H_a as logical complements of each other. The significance level is the largest acceptable probability for an error of type I.

   (2) Assumptions, stating and checking (if possible).

   (3) Test statistic, obtain the data and find test statistic, including degrees of freedom.

   (4) P-value. The P-value measures how likely we would see the sample data (or something more extreme) if H_0 would be true. Therefore a small P-value delivers a contradiction to the assumption that H_0 is true, then H_a as the logical complement must be true.

   (5) Decision (reject H_0/do not reject H_0).

   (6) Context, now interpret what the decision means in the context of the problem.