

Mistakes

We all make them. Even statistical analysts



But first...Let's go on a holiday!





No Jellyfish here!!

Jellyfish?

In the boat, we are forming a hypothesis and a null hypothesis

H₀ = There are no jellyfish in the water. Going swimming will not lead to getting stung

H₁ = There will be jellyfish in the water. Going swimming may lead to getting stung.



I still think there
might be jellyfish...

Your choice, pal.
The water is safe.



Oh no...we made an error. A type 1 error

We rejected the null hypothesis when it was true! We could have gone swimming and been safe from the jelly fish.

P.S. Rejecting the null hypothesis when it is true means the same thing as accepting the Alternate hypothesis when it is false!
Moving on...





No Jellyfish here!!

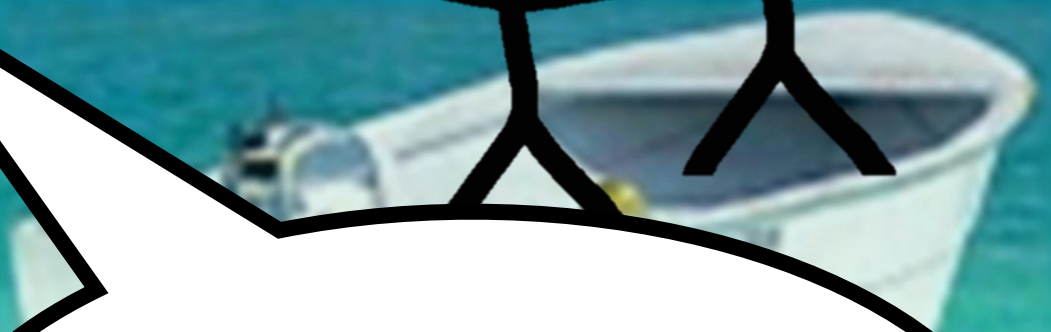
Jellyfish?

In the boat, we are forming a hypothesis and a null hypothesis

H₀ = There are no jellyfish in the water. Going swimming will not lead to getting stung

H₁ = There will be jellyfish in the water. Going swimming may lead to getting stung.



Two simple black stick figures with smiling faces are standing in a small white boat. The boat is on a blue body of water. The figure on the left is slightly behind the one on the right. Both figures have their arms outstretched.

I'm going to trust
that there are no
jellyfish!

Great! Let's swim!

OH NO!!!

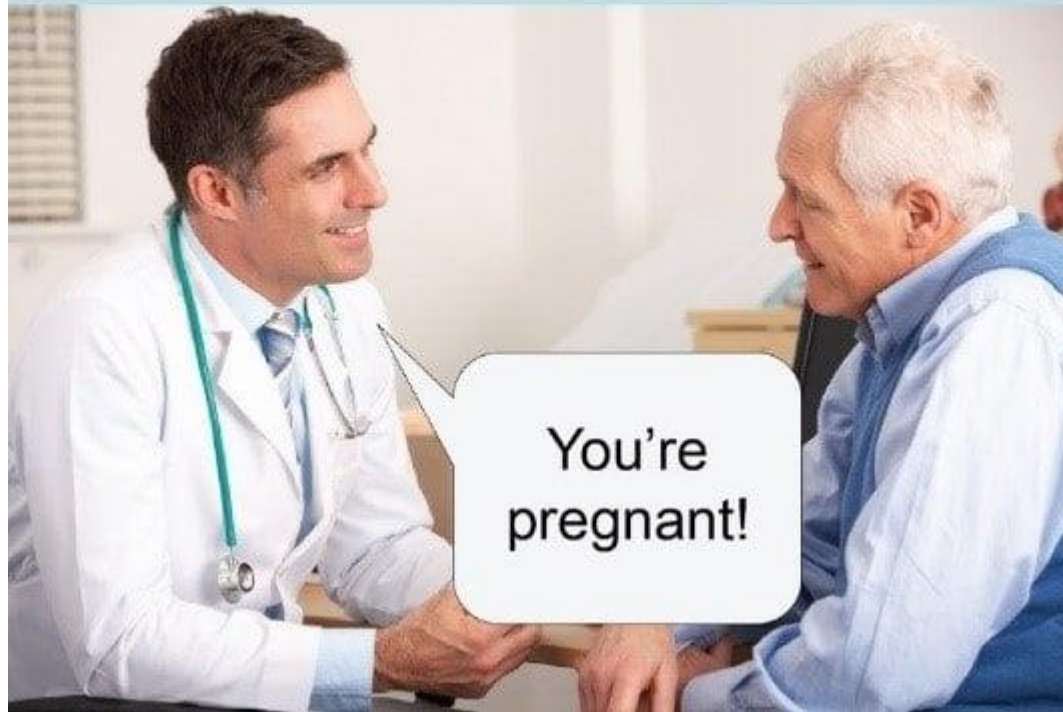
Oh no...we made an error. A type 2 error

We rejected the alternate hypothesis when it was true! We went swimming and got stung! Ouch!



Side by side visualization

Type I Error



Type II Error



Let's look at a HR
example!





We need to improve the level of English in our company. Please ensure all new hires are competent in the language.

How can we do this?

You decide that the hiring process will now include a written English test




In the office, you are forming a hypothesis and a null hypothesis

H0 = The written test will have no impact on the selection of candidates with proficient English.

H1 = The written test will have a positive impact on the selection candidates with proficient English



An illustration of a job interview. A man with brown hair and glasses, wearing a dark suit, is sitting in a brown office chair on the left, facing right. A woman with brown hair, wearing a red blazer over a white shirt and a name tag, is sitting on the right side of a wooden desk, facing left. A laptop is open on the desk in front of her. Two speech bubbles are present: one from the man and one from the woman.

**omdat ik een
job nodig
heb.**

**Vertel ons waarom
we jou zouden
moeten aannemen.**

**But then you
conduct your
interview in
Dutch!**

You end up
with new
hires who
cannot speak
English
proficiently!
Whoops!

A Type 1 error has occurred. We rejected our null hypothesis even though it was true!

H₀ = The written test will have no impact on the selection of candidates with proficient English.

A **Type 1 error** is caused either by random chance or poor study design. It is a **FALSE POSITIVE**

In this case, the study design is the problem.



You decide to change tactics...

A simple black stick figure with a circular head and a smiling face. A large speech bubble originates from the figure's head, containing text.

**We'll have an English portion in
the interview too!**

**But only 3 people apply for the job. 2 fail the
written English test, and 1 passes. You invite
them all for an interview.**

**Well this job will be very hard
given I don't know what I am
doing.**

**You're asking for a very high
salary when you have no
experience...**



**All of the
candidates speak
English well at the
interview...**

**My weakness is that I always
speak my mind.**

**Please tell me some of your
weaknesses.**



**And you end up
hiring someone
who failed the
written test....**

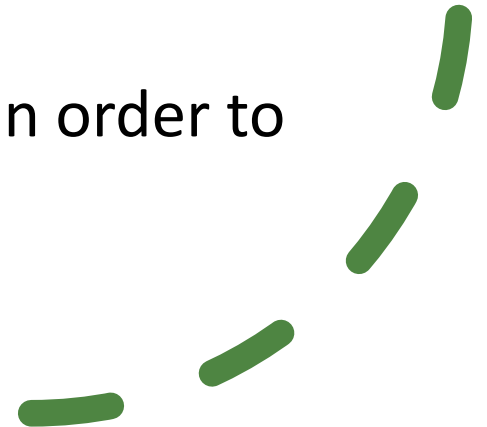
But it turns out that his English isn't as good as it appeared in the interview, especially when it comes to paperwork.

A type 2 error has occurred! We rejected our alternate hypothesis even though it was true!

H1= The written test will have a positive impact for selecting candidates with proficient English

A **Type 2 error** is caused by not enough statistical power (replicates, candidates, sample size etc). It is a **FALSE NEGATIVE**

We needed more candidates than 3 in order to validate this hypothesis



To summarize

There are two kinds of Errors: Type 1 and Type 2

Type 1 is a FALSE POSITIVE.

A researcher accepts H_1 when they should have accepted H_0 .

Something that is not significant is reported to be significant

Type 2 is a FALSE NEGATIVE

A researcher accepts H_0 when they should have accepted H_1 .

Something that is actually significant is not reported