Twitter Thread by Santiago



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You gotta think about this one carefully!

Imagine you go to the doctor and get tested for a rare disease (only 1 in 10,000 people get it.)

The test is 99% effective in detecting both sick and healthy people.

Your test comes back positive.

Are you really sick? Explain below ■

The most complete answer from every reply so far is from Dr. Lena. Thanks for taking the time and going through it!

https://t.co/jGt006Vlh5

> Really doesn\u2019t fit well in a tweet. pic.twitter.com/xN0pAyniFS
>
> — Dr. Lena Sugar \U0001f3f3\ufe0f\u200d\U0001f308\U0001f1ea\U0001f1fa\U0001f1ef\U0001f1f5 (@_jvs) February 18, 2021

You can get the answer using Bayes' theorem, but let's try to come up with it in a different —maybe more intuitive— way.

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$$P(A|B) = \frac{P(B|A)P(A)}{P(B)}$$

Here is what we know:

- Out of 10,000 people, 1 is sick
- Out of 100 sick people, 99 test positive
- Out of 100 healthy people, 99 test negative

Assuming 1 million people take the test (including you):

- 100 of them are sick
- 999,900 of them are healthy

■

Let's now test both groups, starting with the 100 people sick:

■■ 99 of them will be diagnosed (correctly) as sick (99%)

■■ 1 of them is going to be diagnosed (incorrectly) as healthy (1%)

■

Let's now test the group of 999,900 healthy individuals:

■■ 989,901 of them will be diagnosed (correctly) as healthy (99%)

■■ 9,999 of them will be diagnosed (incorrectly) as sick (1%)

■

Since your test came back positive, it means that you belong to either one of the groups that had a positive result:

1. 99 people that are truly sick, or
2. 9,999 people that are actually healthy (but were diagnosed as sick.)

■

Basically, out of 10,098, only 99 are truly sick.

That'll give you a 0.98% chance of being sick!

So no, most likely, you are fine!

■

Here is something important: this is true as long as our only priors are that 1 in 10,000 people have the disease.

For example, if you were showing symptoms, then your chance of being sick after receiving a positive test will be higher.